

TUBE MANUAL

EITEL-McCULLOUGH, INC.
SAN CARLOS • CALIFORNIA

general

A QUICK GUIDE TO EIMAC PRODUCTS AND SERVICES OFFERED IN THIS CATALOG

Including...

- Your nearest distributor of modern, fully guaranteed Eimac Vacuum tubes, vacuum capacitors, heat dissipating connectors, air-system sockets, preformed contact finger stock and vacuum switches.
- Your nearest Eimac Field Engineer, who stands ready to give you immediate engineering assistance, any information on deliveries and prices, or provide other information not found in the catalog.
- Eimac tube type numbering system.
- Tube Replacement Chart.
- Prices on Eimac products.

IMPORTANT EIMAC "EXTRAS"

Application Engineering. The Eimac Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proved by Eimac engineers, whose combined knowledge and experience are at your service. Additional contributions by this Eimac department are its Application Bulletins, an expanding service which you receive without obligation.

Field Engineering. Serving as an extension of the Application Engineering Department outside the Eimac plant, Eimac Field Engineers cover the United States, operating out of offices in major cities. They will help you personally with experimental work, problems of technique, etc. Engineers from the Eitel-McCullough plant in San Bruno are available, too, for field consultation throughout the country. As Eimac tubes are world renowned, the same services extend to various countries overseas through the Eimac export division.

general

BurcoTab
DIVIDERS
BURKHARDT CO. • DETROIT

A DATA SHEET FOR THE EIMAC FIELD ENGINEERS IS BEING PREPARED
AND WILL BEMAILED TO YOU FOR INSERTION IN THIS CATALOG

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

Eimac Tube Type Numbering System

Since 1945 all new tube types developed by Eitel-McCullough, Inc. have been given a type number chosen according to a coded number system. This system is designed to convey descriptive information about the tube.

In general, the type numbers consist of: a numeral indicating the number of electrodes, one or more letters denoting special characteristics, a numeral representing the plate dissipation, and a final letter to distinguish the tube from others bearing similar preceding letters and numerals. Triode types carry an additional number to indicate their approximate amplification factor.

To illustrate the method of coding and the information the type number conveys, a 100-watt, ceramic, external-anode, forced-air cooled Eimac triode, type number 3CX100A5, is broken down as follows:

3CX100A5

Number of Electrodes
2–Diode
3–Triode
4–Tetrode
5–Pentode

Plate Dissipation
(Watts)

Amplification Factor
1–0 to 10
2–11 to 20
3–21 to 30
4–31 to 50
5–51 to 100
6–101 to 200
7–201 to 500
8–501 to 1000

Description
C –Ceramic Envelope (No Glass)
L –External Anode, Liquid Convection Cooling
N –External Anode, Natural Convection Air Cooling
P –Primarily for Pulse Applications
*R–Internal Anode, Radiation Cooled
W–External Anode, Water Cooled
X–External Anode, Forced-Air Cooled
*In older types, the dash, as in the case of the 4-250A, carries the meaning of "R" given above.

Version
Distinguishes tubes which, although alike as to number of electrodes and plate dissipation, are not necessarily interchangeable physically or electrically.

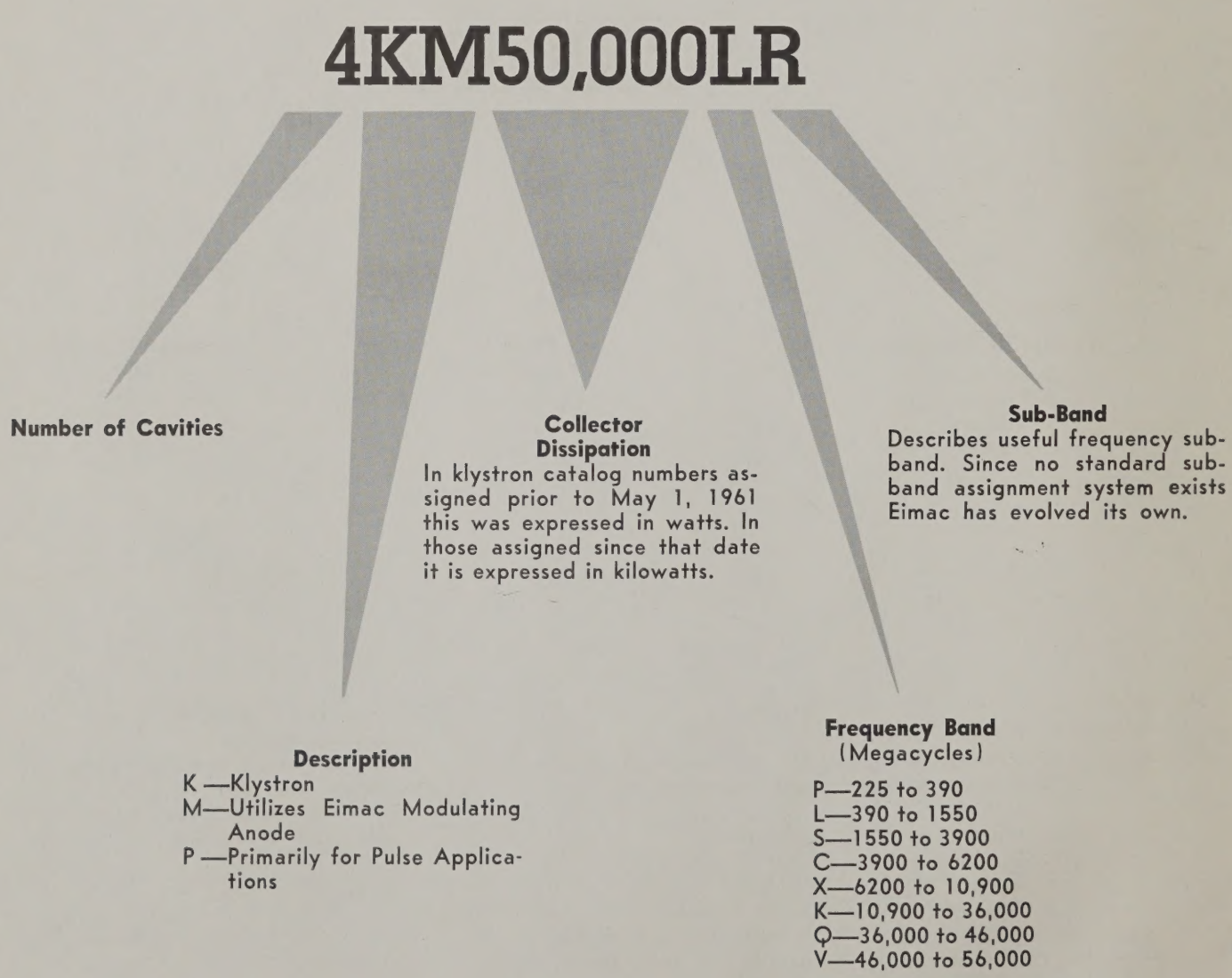
(Effective 4-3-58) Copyright 1950 By Eitel-McCullough, Inc.

Eimac Tube-Type Numbering System for Power Klystrons

In general, Eimac power klystrons are described by a coded numbering system similar to that used to identify negative-grid tubes.

The type numbers contain: a numeral indicating the number of cavities along the beam, one or more letters denoting the type of tube and special characteristics if any, a numeral designating the collector dissipation, and a pair of letters, the first describing the frequency band in which the tube operates and the second describing the sub-band in which it operates.

As an example, the type number describing an Eimac four-cavity klystron with modulating anode and 50,000-watt collector, designed for use in the "L" band is broken down as follows:





EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

EIMAC DISTRIBUTORS

ALABAMA

Birmingham
Ack Radio Supply Company
3101 4th Avenue, South
FA 2-0588

James W. Clary Company
1713 Second Avenue, South
FA 2-2488

M. G. Electronics & Equipment Company
201-3 South 18th Street
FA 2-0449

Dothan
Hand Supply Company
705 South Oates Street
SY 2-3148

Mobile
Forbes Electronic Distributors, Inc.
57 North Washington Avenue
HE 2-7661

ALASKA

Anchorage
Yukon Radio Supply
Box 406
BR 2-7964

Juneau
Alaska Radio Supply
Box 2538
307 Seward
586-3333

ARIZONA

Phoenix
Radio Parts of Arizona
P.O. Box 6345
214 South 11th Avenue
AL 8-6476

Tucson
Inland Electronic Supply
715 East Broadway
MA 4-4404

ARKANSAS

El Dorado
Electronic Service Supply Company
P.O. Box 208
413 West Main
UN 2-4901

Fort Smith
Wise Radio & TV Supply, Inc.
1001 Towson Avenue
SU 3-8926

Little Rock
Carlton-Bates Company
1201 East Sixth Street
FR 5-5375

David White Radio Supply Company
1222 Main Street
FR 6-1391

Texarkana
Lavender Distributing Corporation
518-520 East 4th Street
773-4631

CALIFORNIA

Fresno
Jack C. Arbuckle Company
2349 Kern Street
AM 4-6554

Glendale
R. V. Weatherford Company
6921 San Fernando Road
VI 9-2471

Long Beach
Larry Lynde Electronics
1526 East 4th Street
HE 7-4807

Los Angeles
Henry Radio
11240 West Olympic Blvd.
BR 2-0861

Federated Purchasers, Inc.
11820 West Olympic Blvd.
BR 2-8771

Radio Products Sales Company, Inc.
1501 South Hill Street
RI 9-7471

Oakland
Brill Electronics
610 East 10th Street
TE 2-6100

Elmar Electronics
140 11th Street
TE 4-3311

Palo Alto
Zack Electronics
654 High Street
DA 6-5432

Riverside
Electronic Supply Riverside, Inc.
2486 Third Street
OV 3-8110

Sacramento
Dunlap Electronics, Inc.
1800 22nd Street
HU 1-4821

San Diego
Radio Parts Company
2060 India Street
BE 9-9361

Western Radio & T.V. Supply Company
P.O. Box 1728
1415 India Street
BE 9-0361

San Francisco
Fortune Electronics, Inc.
2280 Palou Avenue
VA 6-8811

Zack Electronics
1422 Market Street
MA 1-1424

San Jose
Peninsula Electronic Supply, Inc.
656 South 1st Street
CY 4-8781

COLORADO

Colorado Springs
D & M Electronic Supply
717 North Weber Street
ME 3-0902

Denver
Denver Electronic Supply Corporation
2170 South Grape Street
SK 7-3351

Inter-State Radio & Supply Company
1200 Stout Street
TA 5-5347

L. B. Walker Radio Company
300 Bryant Street
WE 5-2401

Grand Junction
Radio & Electronic Supply Company
640 White Avenue
CH 3-3346

Pueblo
L. B. Walker Radio Company
100 North Victoria
LI 2-1924

CONNECTICUT

New Haven
Radio Shack Corporation
230-234 Crown Street
SP 7-7941

DISTRICT OF COLUMBIA

Washington
Capitol Radio Wholesalers, Inc.
2120-22 14th Street, N.W.
AD 2-6000

Electronic Wholesalers, Inc.
2345 Sherman Avenue, N.W.
HU 3-5200

FLORIDA

Ellenton
Bill Slep Company
301 Highway
722-1843

Jacksonville
Southeast Audio Company
1125 Roselle Street
356-3007

Melbourne
Electronic Wholesalers, Inc.
1301 Hibiscus Blvd.
PA 3-1441

Miami
Amateur Radio Center, Inc.
2805 N. E. 2nd Avenue
FR 4-4101
East Coast Electronics, Inc.
1900 N. W. Miami Court
371-4635
Electronic Equipment Company
2701 N. W. 42nd Avenue
NE 5-0421
Electronic Wholesalers, Inc.
9390 N. W. 27th Avenue
OX 6-1620
Panama City
Central Electronic Supply
P.O. Box 1700
316 Luverne Avenue
SU 5-4821
Tampa
Thurow Electronics, Inc.
121 South Water Street
229-1885
West Palm Beach
Goddard, Inc.
1309 North Dixie
TE 3-5701

GEORGIA
Atlanta
Specialty Distributing Company
763 Junipera Street, N.E.
TR 3-2521

HAWAII
Honolulu
Honolulu Electronics
816 Keeaumoku Street
999-591
Industrial Electronics, Inc.
565 South Queen Street
6-5176
Polynesian Electronic Distributing Co.
1336-4 Dillingham Blvd.
82-991
Precision Radio, Ltd.
1160 South King Street
50-8291
Radio Television Corporation
777 Ala Moana Boulevard
50-2901

IDAHO
Twin Falls
United Electronics Wholesale
328 Third Street, East
733-7324

ILLINOIS
Chicago
Allied Radio Corporation
111 North Campbell Avenue
TA 9-9100
Newark Electronics Corporation
223 West Madison Street
ST 2-2944
Peoria
Klaus Radio & Electronic Company
403 East Lake
688-3401

INDIANA
Indianapolis
Graham Electronics Supply Company
122 South Senate
ME 4-8486

IOWA
Cedar Rapids
Deeco, Inc.
618 First Street, N.W.
EM 4-2493
Council Bluffs
World Radio Laboratories, Inc.
3415 West Broadway
328-1851
Davenport
TCR Distributors
1205 East River Drive
323-8051
Des Moines
Radio Trade Supply Company
1224 Grand Avenue
AT 8-7237
Mason City
Waters Electronic Supply
516 South Delaware
GA 3-5889

KANSAS
Wichita
Radio Supply Company, Inc.
115 Laura
AM 7-0881

KENTUCKY
Louisville
P. I. Burks & Company, Inc.
659 South 9th Street
JU 4-0254

LOUISIANA
Alexandria
Central Radio Supply Company, Inc.
601 North Third Street
3-4517
Lafayette
Ralph's of Lafayette, Inc.
3004 Cameron Street
CE 4-4507
New Orleans
EPCOR
3622 Toulouse Street
HU 6-3777
Radio Parts, Inc.
1112 Magazine Street
JA 2-0217
Shreveport
Interstate Electric Co. of Shreveport, Inc.
1419 Culpepper Street
3-6131
Lavender Distributing Corporation
1549 Wilkinson Avenue
3-7161

MARYLAND
Baltimore
Kann-Ellert Electronics, Inc.
2050 Rockrose Avenue
TU 9-4242

MASSACHUSETTS
Boston
Demambro Radio Supply Company, Inc.
1095 Commonwealth Avenue
AL 4-9000
Radio Shack Corporation
Industrial Division
730 Commonwealth Avenue
RE 4-6811
Newton
Cramer Electronics, Inc.
320 Needham Street
WO 9-7700
Springfield
Soundco Electronic Supply Co., Inc.
147 Dwight Street
RE 9-3847

MICHIGAN
Battle Creek
Electronic Supply Corporation
94 Hamblin Avenue
WO 5-1241
Detroit
Newark-Ferguson Electronics, Inc.
20700 Hubbel Avenue
JO 4-5490
Flint
Shand Radio Specialties, Inc.
2608 Leith Street
CE 2-9714

MINNESOTA
Duluth
Northwest Radio
123 East 1st Street
RA 7-1565
Mankato
Southern Minnesota Supply Company
Corner Second & Main
4501
Minneapolis
Electronic Center, Inc.
107 3rd Avenue, N.
FE 8-8678
Lew Bonn Company
1211 La Salle
339-9461

MISSISSIPPI
Jackson
Swan Electronics, Inc.
342 North Gallatin Street
FL 2-5516

MISSOURI
Butler
Henry Radio Company
211 North Main
Phone: 395
Joplin
Norman Electronics
402 Wall Street
MA 4-0368
Kansas City
Walters Radio Supply
3635 Broadway
VA 1-8058

St. Louis
Interstate Industrial Electronics, Inc.
8406 Olive Street Road
WY 4-7585
Olive Industrial Electronics
6662 Olive Street Road
VO 3-4051
Van Sickle Radio Company
1113 Pine Street
CH 1-1814
Walter Ashe Radio Company
1125 Pine Street
CH 1-1125

MONTANA

Billings
Electronic Supply Company
214 11th Street, West
2-2197
Heald Supply Company
2112 4th Avenue, North
245-5141

NEBRASKA

Lincoln
Scott Electronic Supply Company
2201 "O" Street
2-6558
Scottsbluff
Joachim Radio Supply, Inc.
1913 Broadway
ME 2-2181

NEVADA

Reno
Electronic Distributing Co. of Nevada
720 Tahoe Street
FA 3-2766

NEW HAMPSHIRE

Concord
Evans Radio, Inc.
P.O. Box 312
CA 5-3358

NEW JERSEY

Princeton
Sun Radio & Electronics Co., Inc.
206 Center, Route 206
OR 5-8600
Springfield
Federated Purchasers, Inc.
155 U. S. Route 22
DI 9-3050

NEW MEXICO

Alamogordo
Kierulff Electronics Company, Inc.
209 Pennsylvania Avenue
HE 7-0370
Albuquerque
Midland Specialty Company
1712 Lomas Blvd., N.E.
247-2486
Radio Equipment Company
523 Central, N.E.
CH 2-5681
Roswell
R & R Electronic Supply Company
605 East Second Street
MA 2-0670

NEW YORK

Albany
Fort Orange Radio Dist. Co., Inc.
904-916 Broadway
HE 6-8411
Buffalo
Radio Equipment Corporation
312 Elm Street
TL 6-1415
Lynbrook, L. I.
Peerless Radio Distributors, Inc.
19 Wilbur Street
LY 3-2121
Mineola, L. I.
Arrow Electronics, Inc.
525 Jericho Turnpike
PI 6-8686
New York City
Calvert Electronics, Inc.
220 East 23rd Street
OR 9-1340
Electronic Tube Sales
161 Washington Street
BA 7-4141
Harrison Radio Corporation
225 Greenwich Street
BA 7-7777
Harvey Radio Company, Inc.
103 West 43rd Street
JU 2-1500
Milgray Electronics, Inc.
160 Varick Street
YU 9-1600
Milo Electronics Corporation
530 Canal Street
BE 3-2980
Sun Radio & Electronics Co., Inc.
650 6th Avenue
OR 5-8600
Terminal-Hudson Electronics, Inc.
236 West 17th Street
CH 3-5200
Rochester
Rochester Radio Supply, Inc.
140 West Main Street
LO 2-9900
Syracuse
Syracuse Radio Supply
620 South Sabina Street
GR 5-0161

NORTH CAROLINA

Ashville
Freck Radio & Supply Company
38 Biltmore Avenue
AL 3-3631
Raleigh
Southeastern Radio Supply Company
414 Hillsboro Street
TE 3-1936
Winston Salem
Electronic Wholesalers, Inc.
938 Burke Street
PA 5-8711

NORTH DAKOTA

Fargo
Bristol Distributing Company
1345 Main Street
AD 2-7493
Minot
John Iverson Company
216 2nd Street, S.W.
TE 2-3117

OHIO

Cincinnati
Hughes Peters, Inc.
1128 Sycamore Street
DU 1-7625
Cleveland
Pioneer Electronics Supply
5403 Prospect Avenue
432-0010
Columbus
Hughes Peters, Inc.
481 East 11th Street
AX 4-5351
Dayton
Srepco Electronics, Inc.
314 Leo Street
224-3871
Stotts Friedman Company
108 North Jefferson Street
BA 4-1111
Toledo
Warren Radio Company
1002 Adams Street
CH 8-3364
Youngstown
Ross Radio, Inc.
325 West Federal Street
RI 6-8881

OKLAHOMA

Lawton
Reynolds Radio Supply Company
908 B Avenue
EL 5-1292
Oklahoma City
Radio Supply, Inc.
724 North Hudson
CE 2-6128
Tulsa
Radio, Inc.
1000 South Main Street
LU 7-9124
S & S Radio Supply
537 South Kenosha Street
LU 2-7173

OREGON

Medford
Verl Walker Company
205 West Jackson Street
773-7557
Portland
Lou Johnson Company
1506 N. W. Irving Street
CA 2-9551
United Radio Supply
22 N. W. Ninth Avenue
CA 6-6335

PENNSYLVANIA

Altoona
Allegheny Electronics, Inc.
1720 Union Avenue
WI 4-0828

Philadelphia
Almo Radio Company, Inc.
913 Arch Street
WA 2-5918

Philadelphia Electronics, Inc.
1225 Vine Street
LO 8-7444

Pittsburgh
Cameradio
1121 Penn Avenue
EX 1-4000

Reading
George D. Barbey Company
157-159 Penn Street
FR 6-7451

Scranton
Fred P. Pursell Company
1221-1227 North Washington Avenue
DI 6-2011

State College
Alvo Electronics Distributors, Inc.
103 South Pugh Street
AD 8-6277

SOUTH CAROLINA

Charleston
Wholesale Radio Supply Company
515 East Bay Street
RA 2-2634

Columbia
Dixie Radio Supply Company
1900 Barnwell Street
AL 3-5333

Greenville
Carolina Radio Supply Company
221 W. Washington Street
CE 9-5125

SOUTH DAKOTA

Rapid City
Ellis Electronics Supply
253 East Main
FI 2-0360

Sioux Falls
Warren Supply Company
196 East 6th Street
ED 4-6942

Watertown
Burghardt Radio Supply, Inc.
Box 746
TU 6-5749

TENNESSEE

Jackson
L. K. Rush Company, Inc.
425-27-29-31 N. Royal Street
2-6533

Knoxville
McClung Appliances
310 Georgia Street, N.E.
4-1811

Nashville
Electra Distributing Company
1914 West End Avenue
AL 5-8444

Tullahoma
Randolph & Holt, Inc.
304 South Atlantic Street
GL 5-4531

TEXAS

Corpus Christi
Electronic Equipment & Engineering Co.
805 South Staples Street
TU 3-9271

Dallas
Adleta Electronics Company
1914 Cedar Springs
RI 1-3152

Engineering Supply Company
6000 Denton Drive
FL 7-6121

Wholesale Electronics Supply
2809 Ross Avenue
TA 4-3001

El Paso
McNicol, Inc.
3012 East Yandell Street
LO 6-2936

Midland Specialty Company
2235 Wyoming Avenue
KE 3-9555

Houston
Busacker Electronic Equip. Co., Inc.
1216 West Clay
JA 6-4661

Laredo
Guarantee Radio Supply Company
1314 Iturbide Street
RA 2-3233

Pan American Electronic Company
1015 Iturbide Street
RA 3-6913

Lubbock
B & L Radio & TV Supply, Inc.
2424 Texas Avenue
PO 5-6352

Port Arthur
Diehl Radio & TV Supply
2120 7th Street
YU 2-6311

San Antonio
The Perry Shankle Company
1801 South Flores Street
CA 3-1801

Radio & Television Parts Company
1828 North St. Mary's Street
CA 7-7503

UTAH

Salt Lake City
Electronic Sales Corporation (ELSCO)
167 Social Hall Avenue
359-7691

S. R. Ross, Inc.
1212 South State Street
DA 8-0591

Standard Supply Company
225 East 6th South Street
EL 5-2971

VIRGINIA

Charlottesville
Virginia Radio Supply Co., Inc.
Box 1189
296-4184

Norfolk
Priest Electronics, Inc.
6431 Tidewater Drive
885-0141

Richmond
Meridian Electronics, Inc.
1001 West Broad Street
EL 5-2834

Roanoke
H. C. Baker Sales Company, Inc.
19 Franklin Road
DI 4-9209

WASHINGTON

Bellingham
Advanced Electronics
110 Grand Avenue
RE 3-0280

Seattle
C & G Electronics Company
2221 Second Avenue
MA 4-4355

Graybar Electric Co., Inc.
King and Occidental
MU 2-0123

Robert E. Priebe Company
2228 2nd Avenue
MU 2-4354

Spokane
Northwest Electronics
East 730 First Avenue
KE 4-2644

Tacoma
C & G Electronics Company
2502 Jefferson Avenue
BR 2-3181

WEST VIRGINIA

Charleston
Chemcity Electronics, Inc.
1637 Fourth Avenue
DI 2-8151

WISCONSIN

Madison
Satterfield Electronics, Inc.
1900 Park Street
AL 7-4801

Milwaukee
Radio Parts Company, Inc.
1314 North Seventh Street
BR 6-4160

WYOMING

Casper
Fleming Supply, Inc.
328 East "A" Street
236-6056

Hathaway Electronic Supply
333 North Wolcott Street
234-1821

Cheyenne
Houge Radio & TV Supply Company
4012 Central Avenue
2-6474

EITEL-McCULLOUGH, INC.

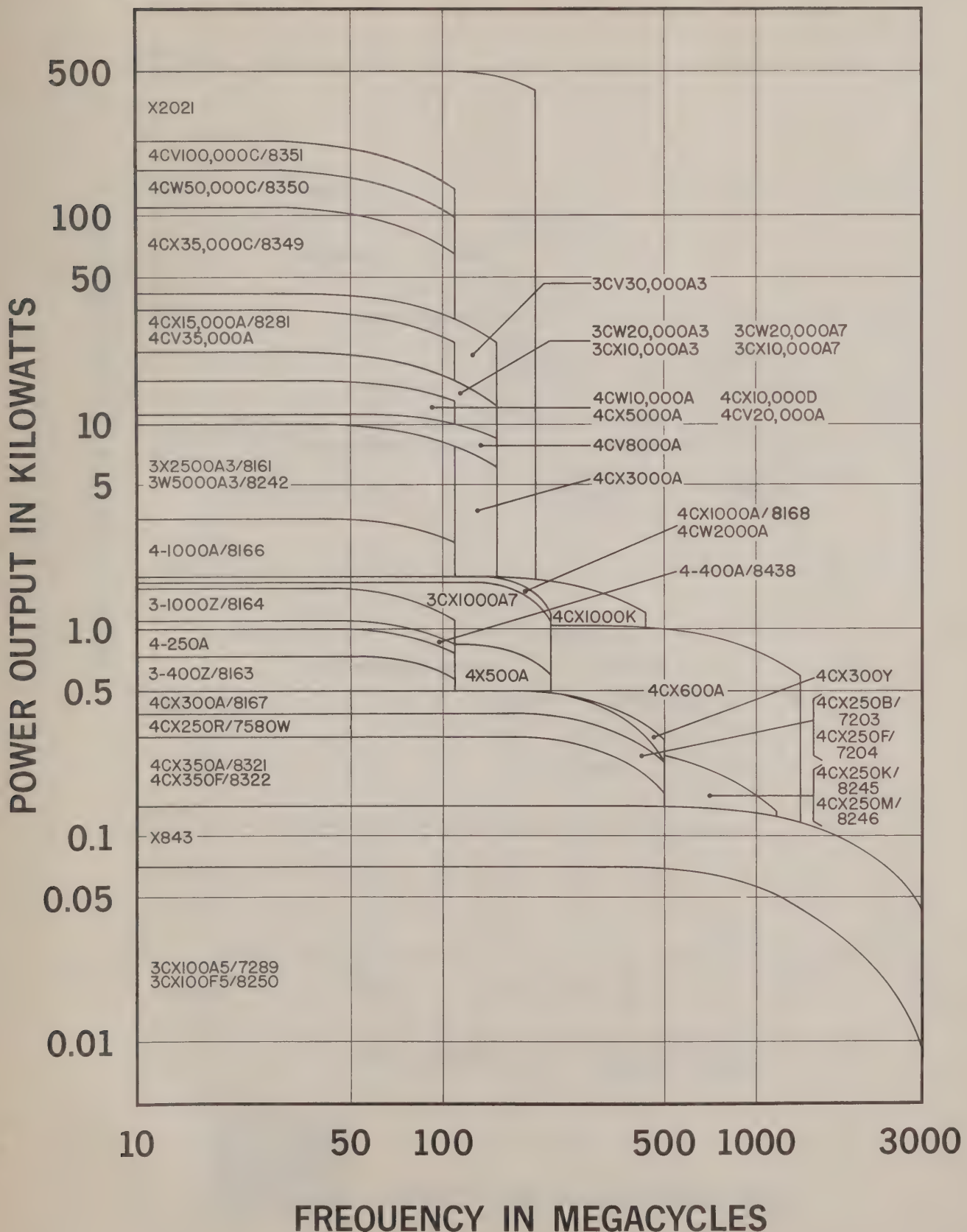
EIMAC and EIA TUBE NUMBER CROSS REFERENCE SHEET

August 18, 1963

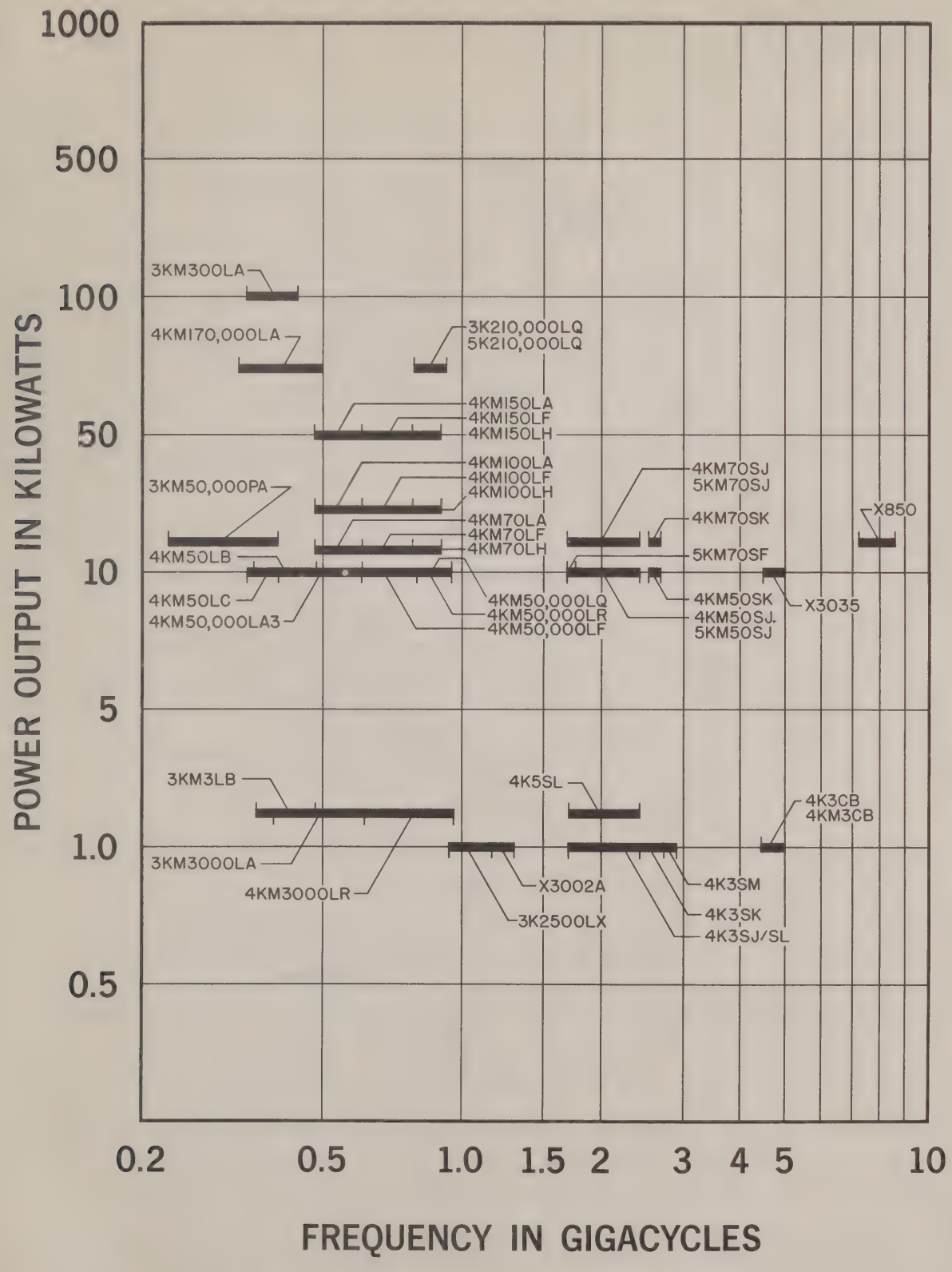
EIMAC NO.	EIA NO.
3CPN10A5	7815
3CPX100A5	7815R
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8238
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3W5000A1	8240
3W5000A3	8242
3W5000F1	8241
3W5000F3	8243
3X2500A3	8161
3X2500F3	8251
3X3000A1	8238
3X3000F1	8239
3X3000F7	8162
3-400Z	8163
3-1000Z	8164
4-65A	8165
4-400A	8348
4-1000A	8166
4CV100,000C	8351
4CW50,000C	8350
4CX250B	7203
4CX250F	7204
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX350A	8321
4CX350F	8322
4CX1000A	8168
4CX3000A	8169
4CX5000A	8170
4CX10,000D	8171
4CX15,000A	8281
4CX35,000C	8349
4PR60B	8252
4PR65A	8187
4PR125A	8247
4PR400A	8188
4PR1000A	8189
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X150R	8296
4X150S	8297

EIA NO.	EIMAC NO.
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7289	3CX100A5
7580W	4CX250R
7815	3CPN10A5
7815R	3CPX100A5
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3X2500A3
8162	3X3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3X3000A1
8239	3X3000F1
8240	3W5000A1
8241	3W5000F1
8242	3W5000A3
8243	3W5000F3
8245	4CX250K
8246	4CX250M
8247	4PR125A
8249	4W300B
8250	3CX100F5
8251	3X2500F3
8252	4PR60B
8281	4CX15,000A
8283	3CX1000A7
8296	4X150R
8297	4X150S
8321	4CX350A
8322	4CX350F
8348	4-400A
8349	4CX35,000C
8350	4CW50,000C
8351	4CV100,000C

POWER GRID TUBES



CW POWER KLYSTRONS

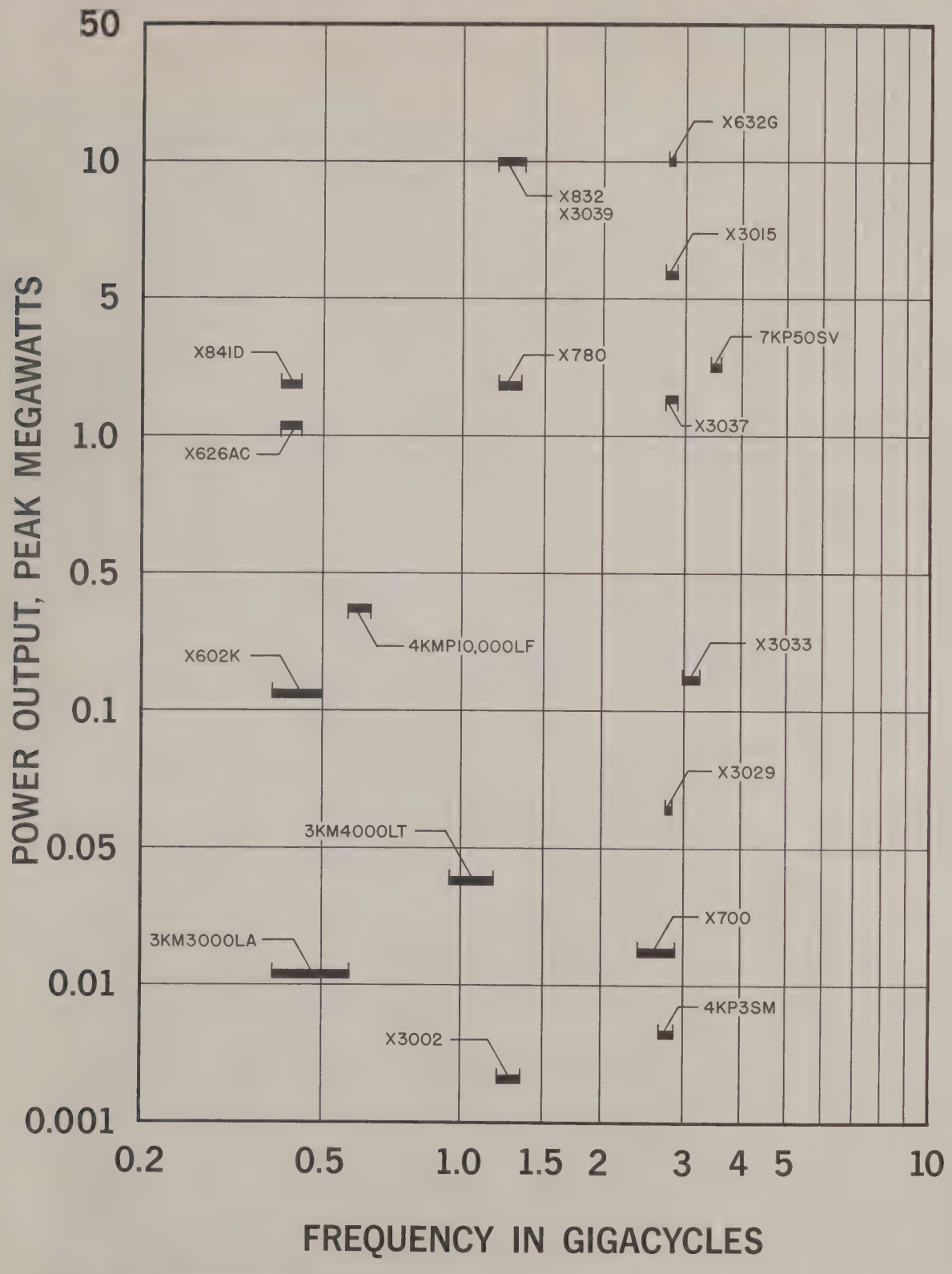


Eimac®

EITEL-McCULLOUGH, INC.

SAN CARLOS · CALIFORNIA

PULSE POWER KLYSTRONS



Eimac®

EITEL-McCULLOUGH, INC.

SAN CARLOS · CALIFORNIA



diodes • rectifiers • pulse modulators

Look in the general section for---

- Your nearest distributor of modern, fully guaranteed Eimac electron tubes and electron tube accessories.
- Your nearest Eimac Field Engineer, who stands ready to give you immediate engineering assistance, information on deliveries and prices, or provide other information not found in the catalog.
- Eimac tube type numbering system.
- Tube Replacement Chart.
- Prices on Eimac products.

IMPORTANT EIMAC "EXTRAS"

Application Engineering. The Eimac Application Engineering Department is available at all times for consultation. New tube operating techniques are continually being explored, tested and proved by Eimac engineers, whose combined knowledge and experience are at your service. Additional contributions by this Eimac department are its Application Bulletins, a service which you receive without obligation.

Field Engineering. Serving as an extension of the Application Engineering Department outside the Eimac plant, Eimac Field Engineers cover the United States, operating out of offices in major cities. They will help you personally with experimental work, problems of technique, etc. Engineers from Eitel-McCullough, Inc. are available, too, for field consultation throughout the country. As Eimac tubes are world renowned, the same services extend to various countries overseas through the Eimac Export Department.

diodes • rectifiers
pulse modulators

Burcotab
DIVIDERS
BURKHARDT CO. · DETROIT

2-01C
INSTRUMENT DIODE

EITEL-McCULLOUGH, INC.

The Eimac 2-01C is a small, closely-spaced, low-capacitance, high-vacuum diode designed for use through ultra-high frequencies. In measurement work, it is well suited to mounting in a probe and will maintain accuracy in the order of ± 1 decibel up to 700 megacycles. It is useful as an indicator at frequencies as high as 3000 megacycles.

The 2-01C has a maximum d-c current rating of 1.0 milliampere and a maximum peak inverse voltage rating of 1000 volts. Cooling is by convection and radiation.

GENERAL CHARACTERISTICS



Actual Size

ELECTRICAL

Cathode—Oxide-Coated, Unipotential

	Min.	Nom.	Max.	
Heating Time	30	60		seconds
Heater Voltage		5.0		volts
Heater Current	0.31		0.39	amperes
Direct Interelectrode Capacitance			0.7	uuf
Zero Signal Voltage (110 Megohm Load)	0.6		1.4	volts
Resonant Frequency		2800		mc
Plate Resistance (E_b=12 volts)		8000	24,000	ohms

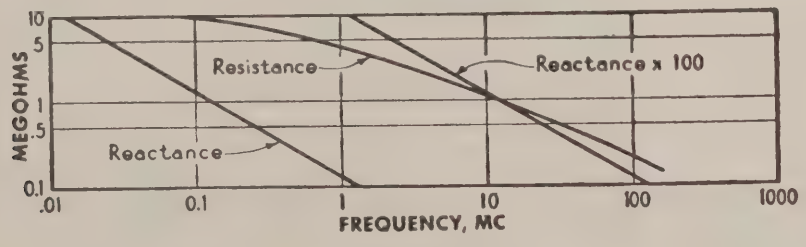
MAXIMUM RATINGS

PEAK INVERSE ANODE VOLTAGE	1000 MAX. VOLTS
D-C PLATE CURRENT	1.0 MAX. MA
PLATE DISSIPATION	0.1 MAX. WATT
SEAL TEMPERATURE	175°C MAX.

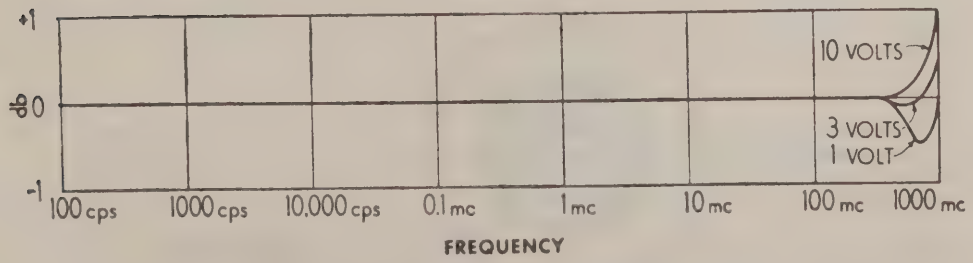
MECHANICAL

Length	1.813 inches	Net Weight	0.2 ounce
Diameter	0.563 inches	Shipping Weight (Approx.)	1.0 pound

INPUT CHARACTERISTICS



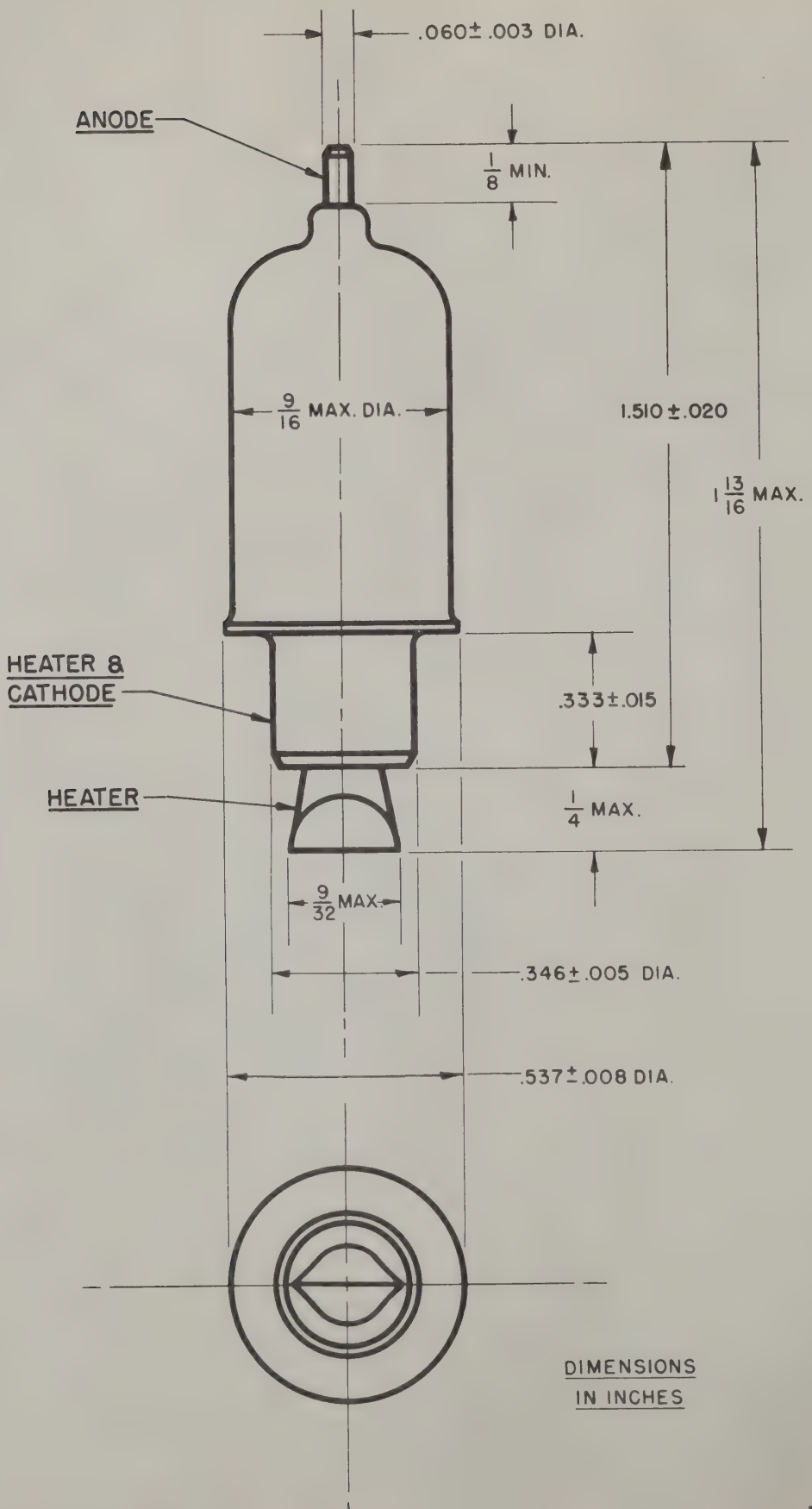
RESPONSE



Input Impedance and Frequency Response of an Eimac 2-01C operating in a Hewlett-Packard Model 410B Vacuum Tube Voltmeter. Reproduced from Hewlett-Packard Catalog No. 21-A, 1952.

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Printed in U.S.A. 1012

EITEL-McCULLOUGH, INC.

2-25A

HIGH-VACUUM RECTIFIER



The Eimac 2-25A diode is a high-vacuum rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 2-25A has a maximum d-c current rating of 50 milliamperes and a maximum peak inverse voltage rating of 25,000 volts. Cooling is by convection and radiation.

A single 2-25A will deliver 40 milliamperes at 10,000 volts to a capacitor-input filter with 8800 volts single-phase supply. Four 2-25A's in a bridge circuit will deliver 100 milliamperes at 15,600 volts to a choke-input filter with 17,600 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	6.3 volts
Current	3.0 amperes

MECHANICAL

Base	Small 4-pin
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-1
Maximum Overall Dimensions:	
Length	4.38 inches
Diameter	1.44 inches
Net Weight	1.2 ounces
Shipping Weight (approx.)	1.0 pound

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	25,000 MAX. VOLTS
PLATE DISSIPATION	15 MAX. WATTS
D-C PLATE CURRENT[1]	50 MAX. MA
PEAK PLATE CURRENT	1.0 MAX. AMPERE

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 2-25A must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The small 4-pin base fits an E. F. Johnson Co. No 122-224, a National Co. No. XC-4 or CIR-4, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 2-25A is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-1 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

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ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 6.3 volts. Variations must be kept within the range from 6.0 to 6.6 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 2-25A reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 2-25A begins to show color as the maximum plate dissipation rating of 15 watts is approached. The maximum peak inverse voltage rating of 25,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 2-25A when used as a power-supply rectifier.

2-25A MAXIMUM-PERFORMANCE CAPABILITIES

Circuit Type	A-C Input Voltage (volts rms)	Capacitor-Input Filter		Choke-Input Filter	
		D-C Output Voltage (volts)	D-C Output Current (ma)	D-C Output Voltage (volts)	D-C Output Current (ma)
Single-Phase, Half-Wave	8800	10,000	40	.....	.....
Single-Phase, Full-Wave	8800[1]	10,000	80	7900	100
Single-Phase, Bridge	17,600	20,000	80	15,800	100

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 2-25A is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 2-25A is 50 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 2-25A is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 2-25A when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 2-25A, which may be taken as 1200 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance (R_c) up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 2-25A is 25,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 2-25A is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 2-25A is 90 milliamperes.

The plate characteristic curve for the 2-25A serves as a guide to special applications. The maximum plate dissipation rating of 15 watts, the maximum peak inverse voltage rating of 25,000 volts, and the maximum peak plate current of 1.0 ampere must not be exceeded.

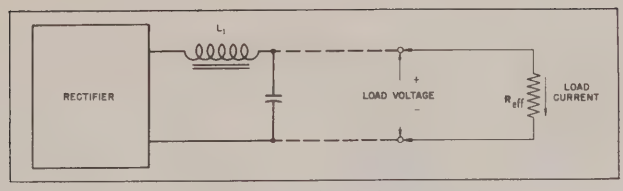
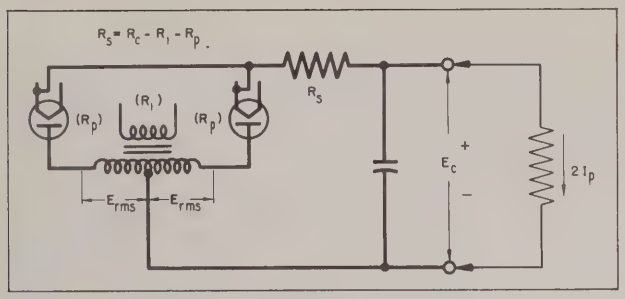
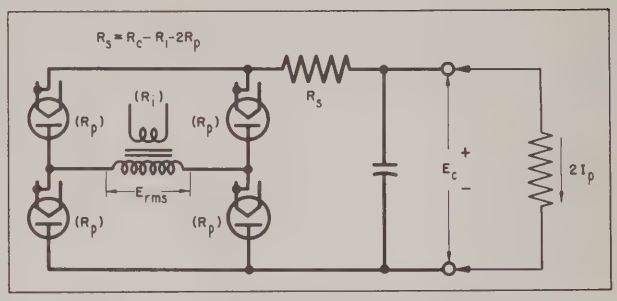


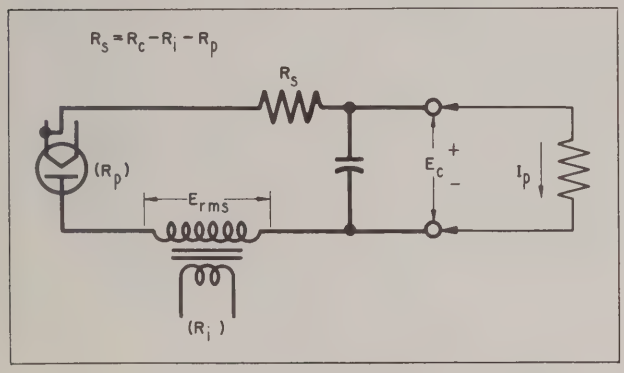
Fig. 1. Rectifier with Choke-Input Filter



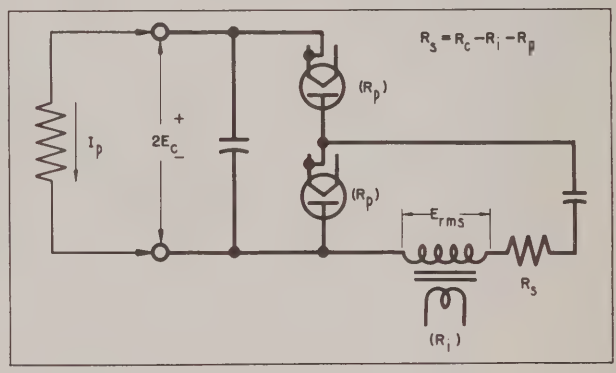
a. Full-Wave Center-Tapped Rectifier



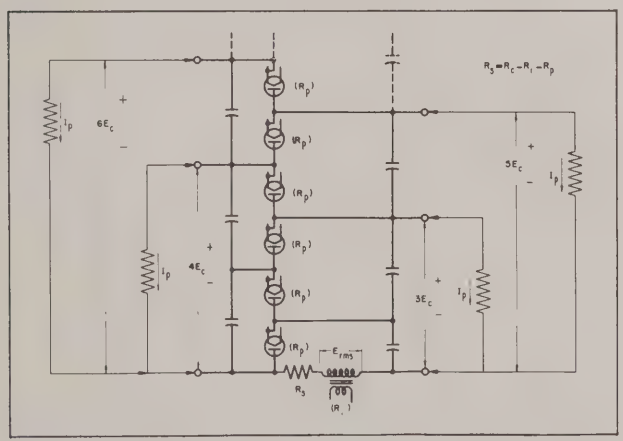
b. Full-Wave Bridge Rectifier



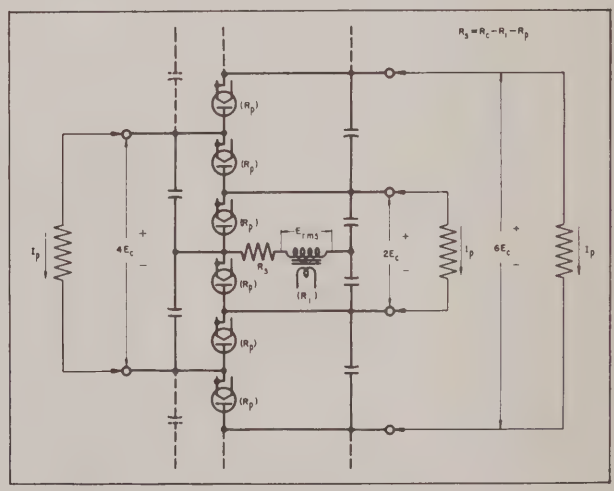
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



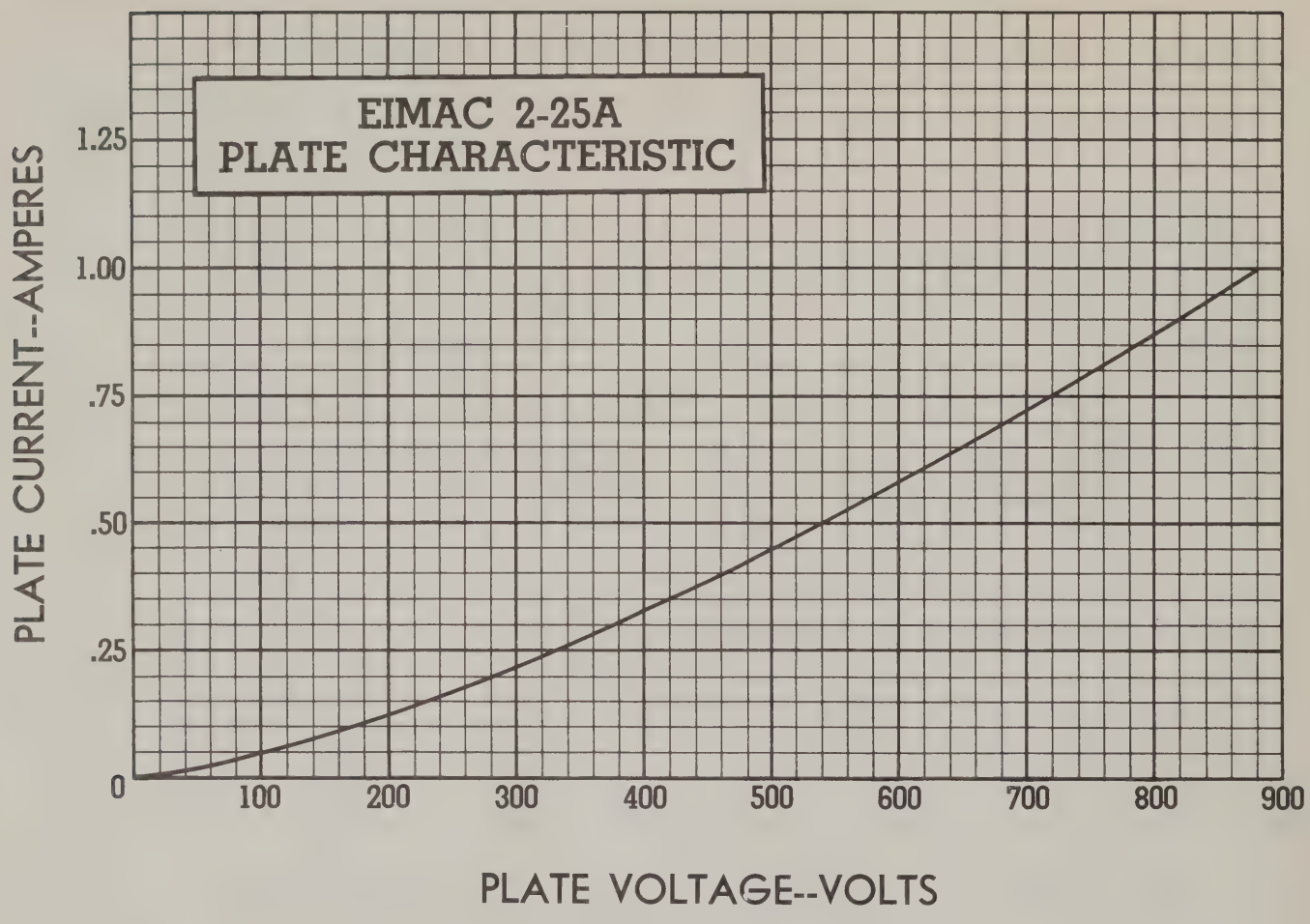
f. Full-Wave Voltage Multiplier

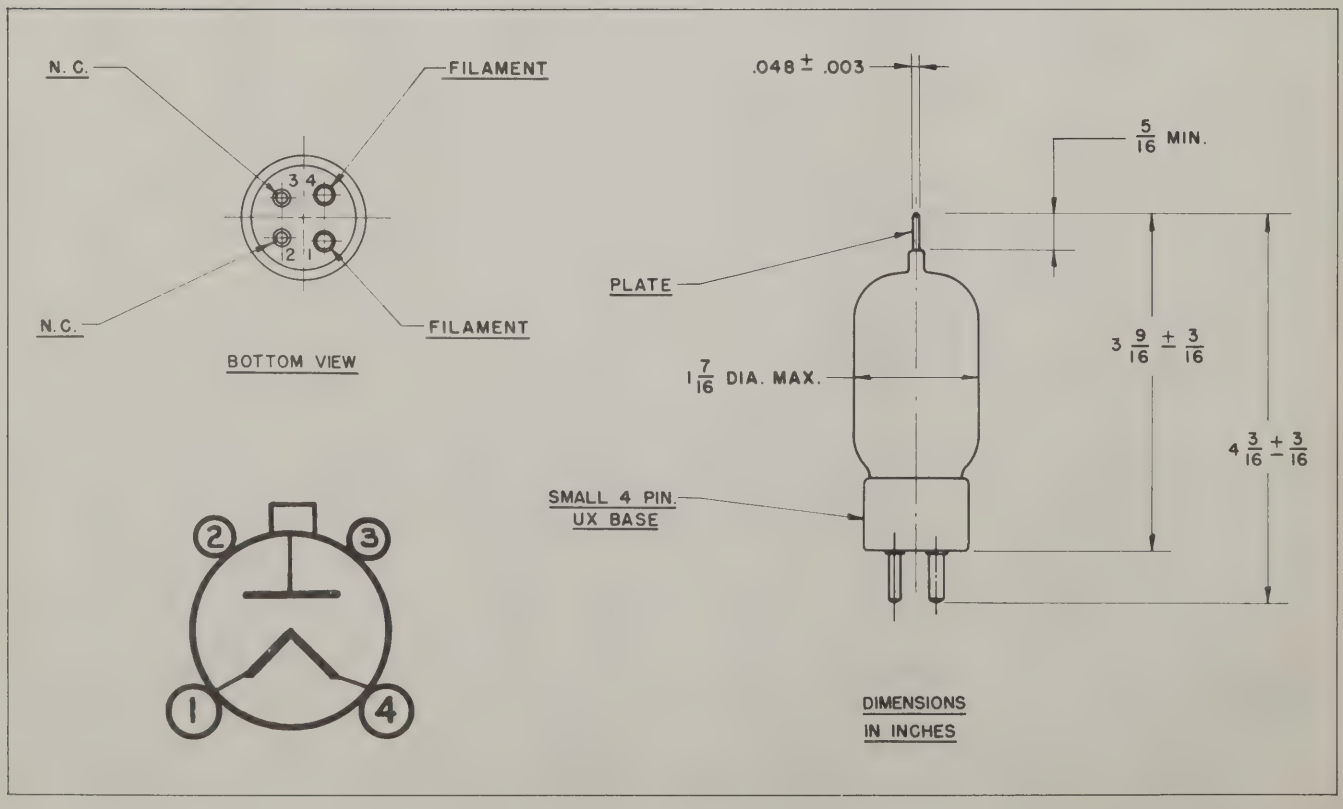
Eimac 2-25A Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	35.0	37.5	40.0	42.5	45.0	47.5	50.0	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.3	2.0	3.4	5.5	9.0	16	27	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.83	0.88	0.94	1.05	1.23	1.50	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.3	2.4	2.5	2.7	3.0	3.5	4.3	times Filter-Input D-C Voltage (E_c)

Fig. 2. Eimac 2-25A Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source.

R_p = 1200 ohms (600 ohms for two tubes in parallel)





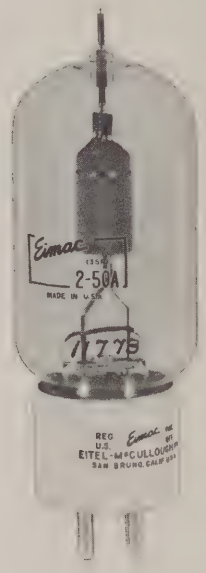
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Eimac®

EITEL-McCULLOUGH, INC.

2-50A

HIGH-VACUUM RECTIFIER



The Eimac 2-50A diode is a high-vacuum rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 2-50A has a maximum d-c current rating of 75 milliamperes and a maximum peak inverse voltage rating of 30,000 volts. Cooling is by convection and radiation.

A single 2-50A will deliver 60 milliamperes at 12,500 volts to a capacitor-input filter with 10,600 volts single-phase supply. Four 2-50A's in a bridge circuit will deliver 150 milliamperes at 19,000 volts to a choke-input filter with 21,200 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	4.0 amperes

MECHANICAL

Base	Medium 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-3
Maximum Overall Dimensions:	
Length	5.50 inches
Diameter	1.82 inches
Net Weight	2.5 ounces
Shipping Weight (approx.)	1.0 pound

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	30,000 MAX. VOLTS
PLATE DISSIPATION	30 MAX. WATTS
D-C PLATE CURRENT[1]	75 MAX. MA
PEAK PLATE CURRENT	1.0 MAX. AMPERE

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 2-50A must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The medium 4-pin base fits an E. F. Johnson Co. No. 122-224, a National Co. No. XC-4 or CIR-4, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 2-50A is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-3 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature

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APPLICATION (Continued)

is "Tempilaq" a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT A HIGH POTENTIAL.

The thoriated-tungsten filament of the 2-50A reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination the plate of the 2-50A begins to show color as the maximum plate dissipation rating of 30 watts is approached. The maximum peak inverse voltage rating of 30,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 2-50A when used as a power-supply rectifier.

2-50A MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voltage (volts)	D-C Output Current (ma)	D-C Output Voltage (volts)	D-C Output Current (ma)
Single-Phase, Half-Wave	10,600	12,500	60	.....	.....
Single-Phase, Full-Wave	10,600[1]	12,500	120	9500	150
Single-Phase, Bridge	21,200	25,000	120	19,000	150

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 2-50A is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 2-50A is 75 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_l in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 2-50A is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 2-50A when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 2-50A, which may be taken as 1000 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 2-50A is 30,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 2-50A is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 2-50A is 145 milliamperes.

The plate characteristic curve for the 2-50A serves as a guide to special applications. The maximum plate dissipation rating of 30 watts, the maximum peak inverse voltage rating of 30,000 volts, and the maximum peak plate current of 1.0 ampere must not be exceeded.

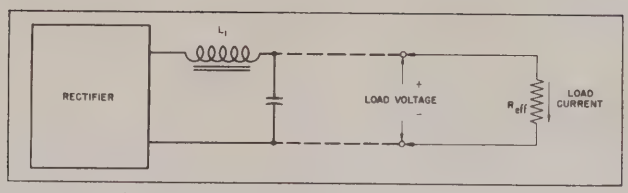
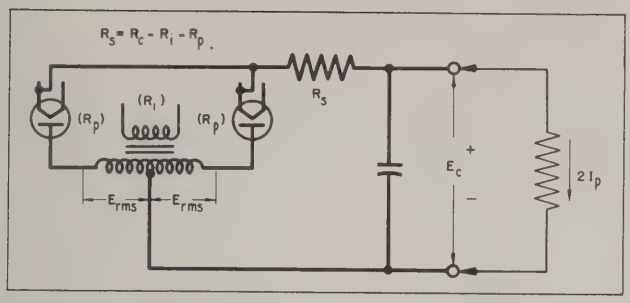
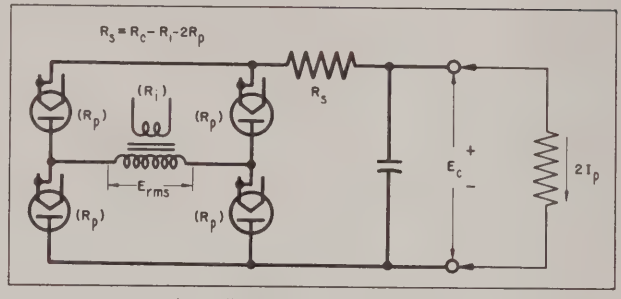


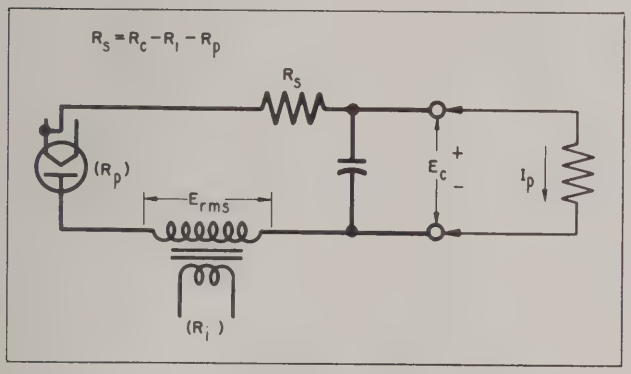
Fig. 1. Rectifier with Choke-Input Filter



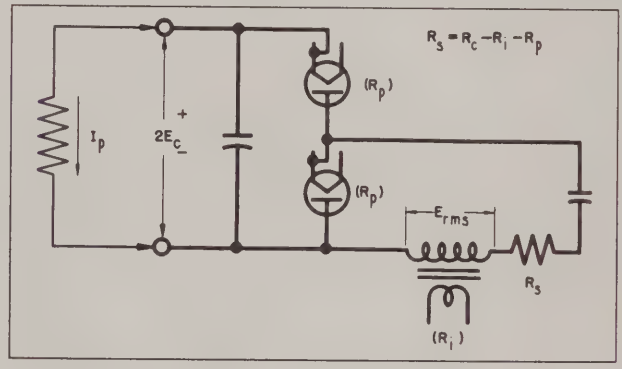
a. Full-Wave Center-Tapped Rectifier



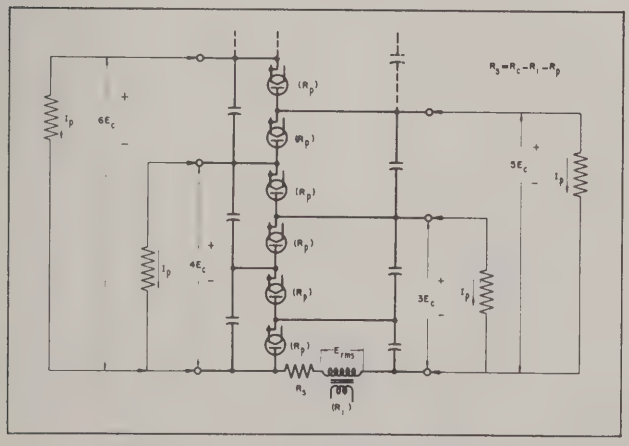
b. Full-Wave Bridge Rectifier



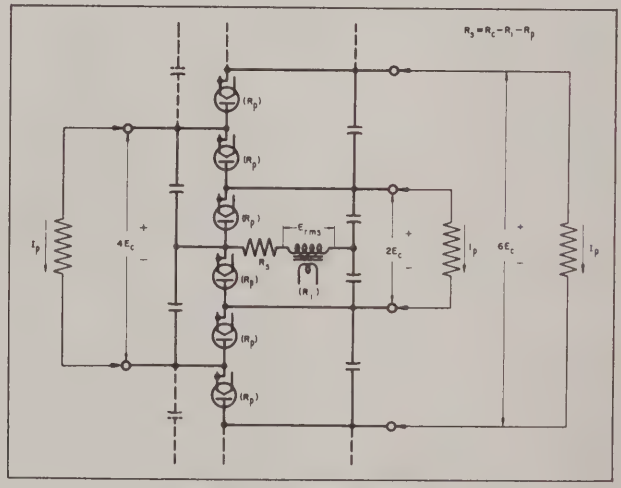
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



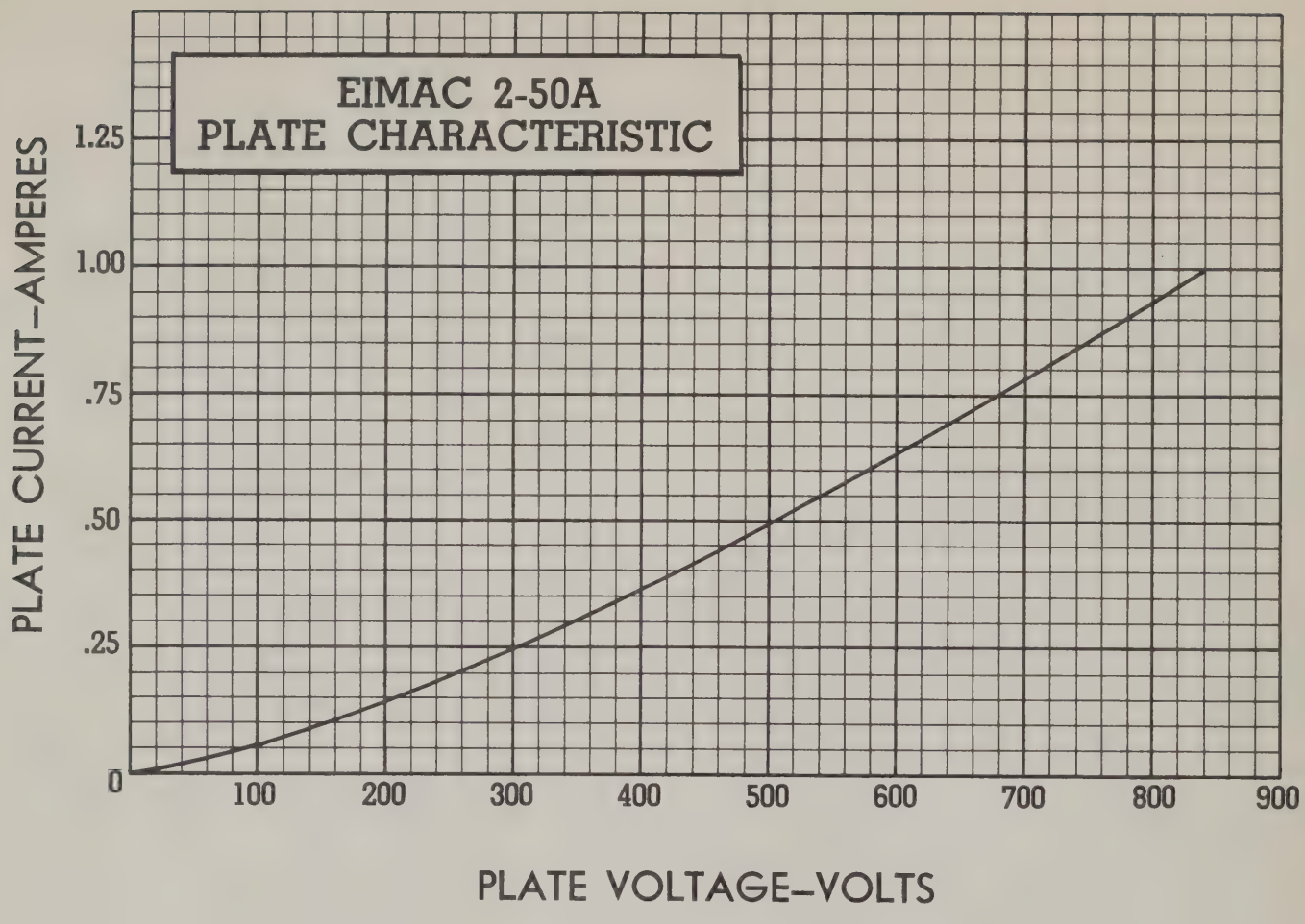
f. Full-Wave Voltage Multiplier

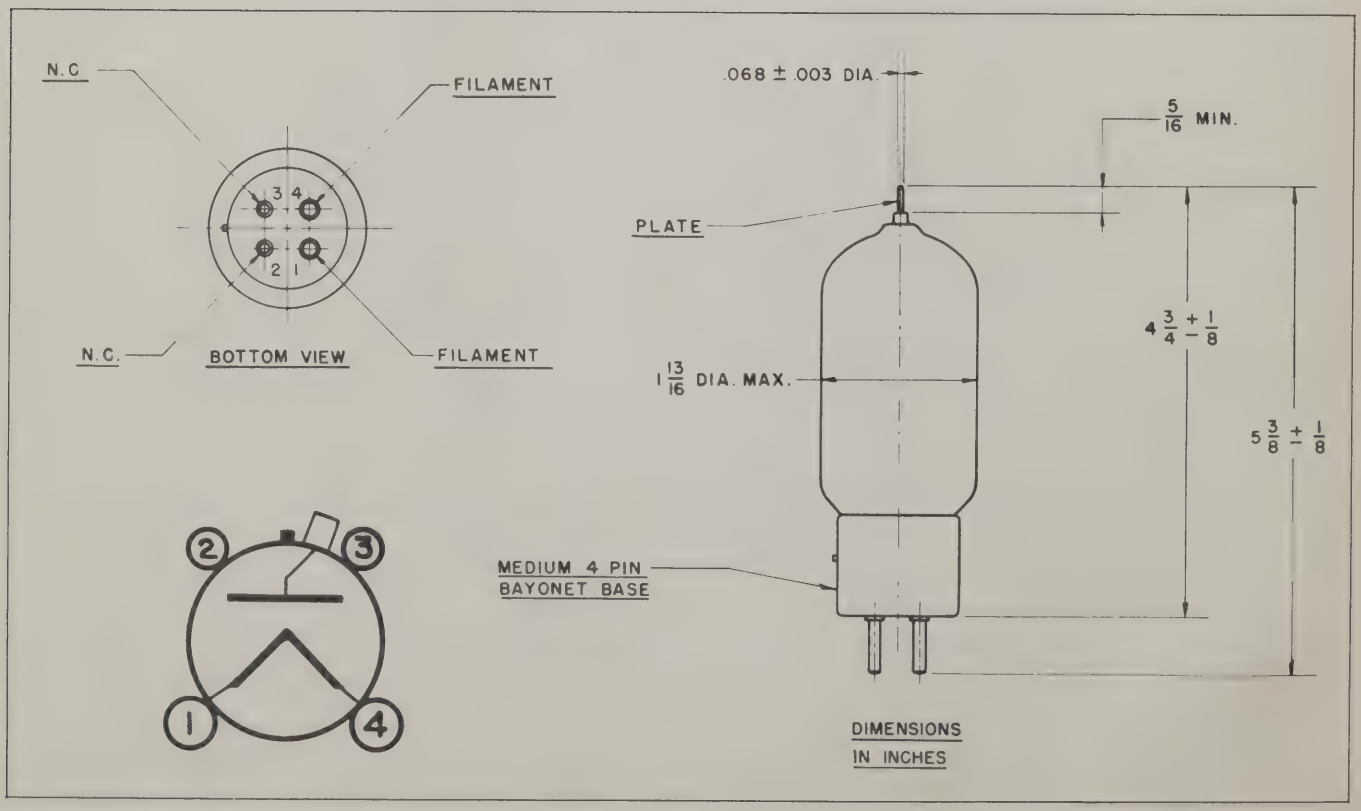
Eimac 2-50A Maxium D-C Current Ratings for R-C Filter Applications						
D-C Plate Current (I_p)	55	60	65	70	75	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.3	2.4	4.7	8.5	17	percent of effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.85	0.92	1.04	1.28	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.3	2.4	2.6	3.0	3.7	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 2-50A Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 1000 ohms (500 ohms for two tubes in parallel)



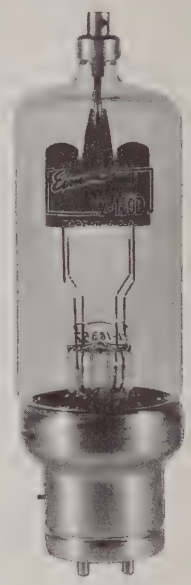


Printed in U.S.A. 831

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EITEL-McCULLOUGH, INC.
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2-150D
HIGH-VACUUM RECTIFIER



The Eimac 2-150D is a high vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 2-150D has a maximum d-c current rating of 250 milliamperes and a maximum peak inverse voltage rating of 30,000 volts. Cooling is by convection and radiation.

A single 2-150D will deliver 200 milliamperes at 11,800 volts to a capacitor-input filter with 10,600 volts single-phase supply. Four 2-150D's in a bridge circuit will deliver 500 milliamperes at 19,000 volts to a choke-input filter with 21,200 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	13.0 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and Radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	8.88 inches
Diameter	2.50 inches
Net Weight	9 ounces
Shipping Weight (approx.)	1 pound

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	30,000 MAX. VOLTS
PLATE DISSIPATION	90 MAX. WATTS
D-C PLATE CURRENT[1]	250 MAX. MA
PEAK PLATE CURRENT	3.0 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 2-150D must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 2-150D is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-6 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature

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APPLICATION (Continued)

is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd Street, New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 2-150D reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 2-150D begins to show color as the maximum plate dissipation rating of 90 watts is approached. The maximum peak inverse voltage rating of 30,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 2-150D when used as a power-supply rectifier.

2-150D MAXIMUM-PERFORMANCE CAPABILITIES

Circuit Type	A-C Input Voltage (volts rms)	Capacitor-Input Filter D-C Output Voltage (volts)	Capacitor-Input Filter D-C Output Current (ma)	Choke-Input Filter D-C Output Voltage (volts)	Choke-Input Filter D-C Output Current (ma)
Single-Phase, Half-Wave	10,600	11,800	200		
Single-Phase, Full-Wave	10,600[1]	11,800	400	9500	500
Single-Phase, Bridge	21,200	23,600	400	19,000	500

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 2-150D is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 2-150D is 250 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 2-150D is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 2-150D when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 2-150D, which may be taken as 300 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the load maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 2-150D is 30,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 2-150D is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 2-150D is 500 milliamperes.

The plate characteristic curve for the 2-150D serves as a guide to special applications. The maximum plate dissipation rating of 90 watts, the maximum peak inverse voltage rating of 30,000 volts, and the maximum peak plate current of 3.0 amperes must not be exceeded.

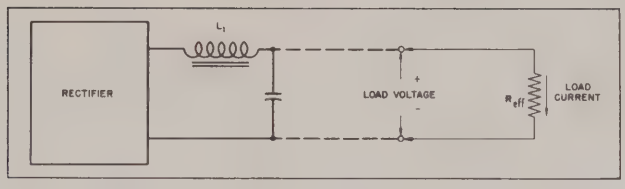
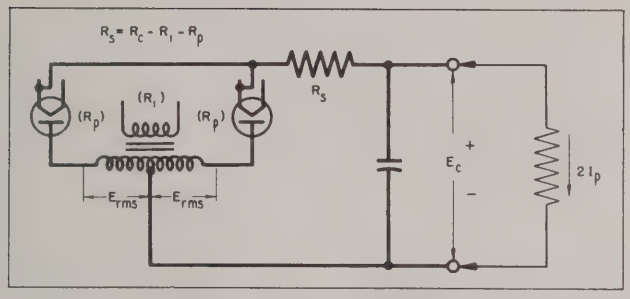
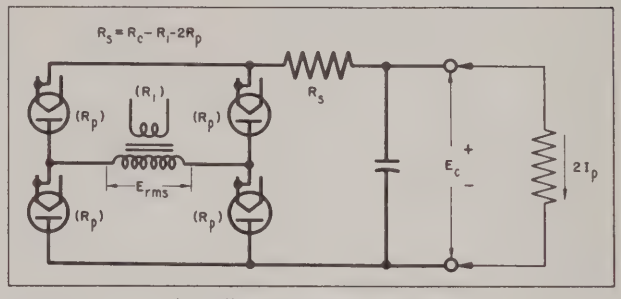


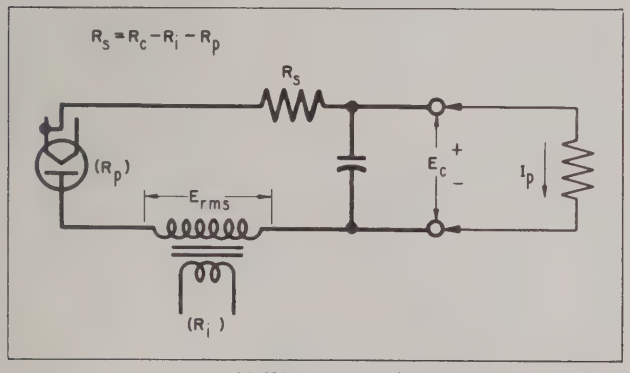
Fig. 1. Rectifier with Choke-Input Filter



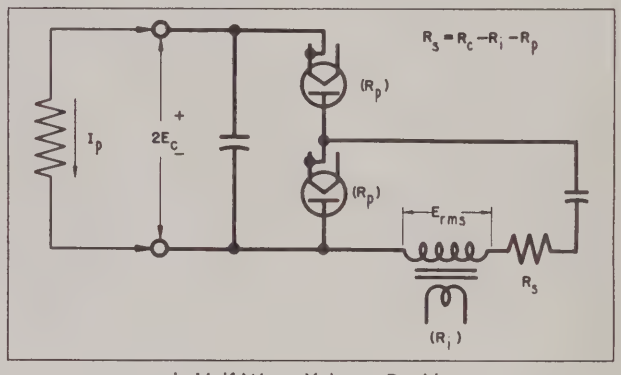
a. Full-Wave Center-Tapped Rectifier



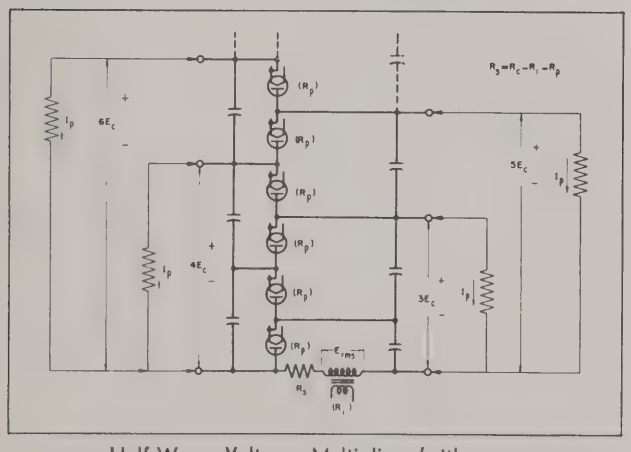
b. Full-Wave Bridge Rectifier



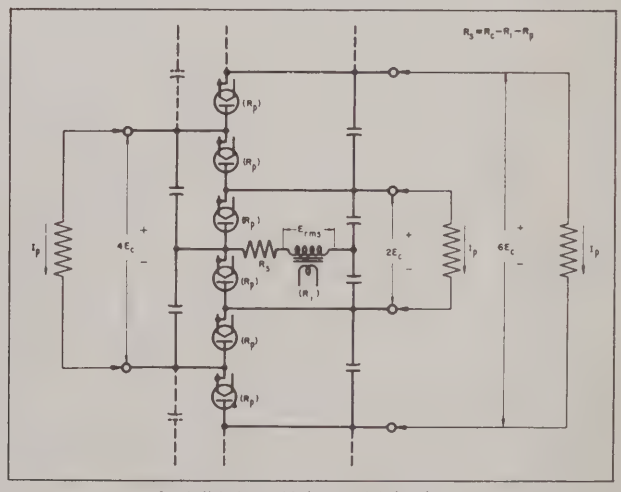
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



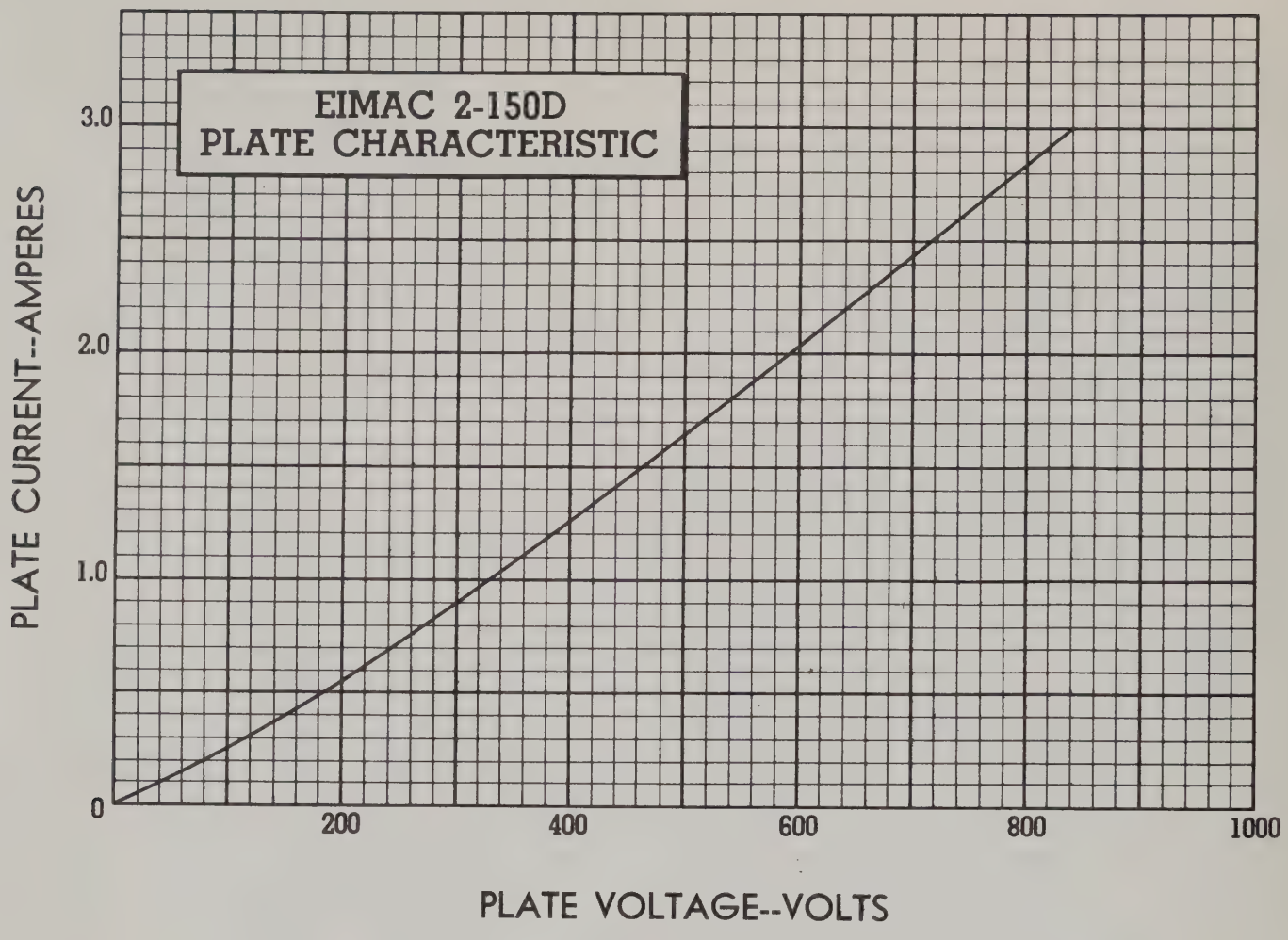
f. Full-Wave Voltage Multiplier

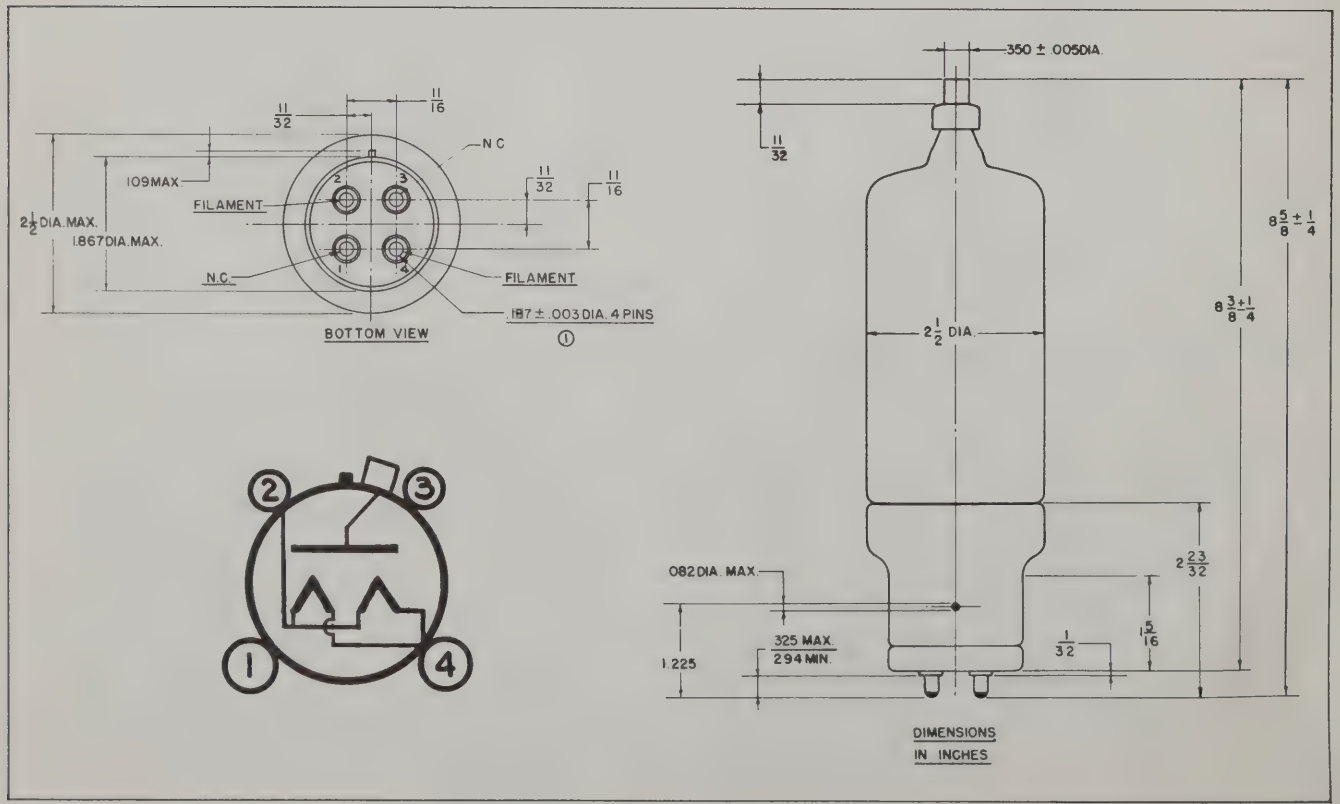
Eimac 2-150D Maximum D-C Current Ratings for R-C Filter Applications						
D-C Plate Current (I_p)	150	175	200	225	250	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	0.7	1.6	3.9	9.6	27	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.78	0.82	0.90	1.07	1.50	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.2	2.4	2.6	3.0	4.3	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 2-150D Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 300 ohms (150 ohms for two tubes in parallel)





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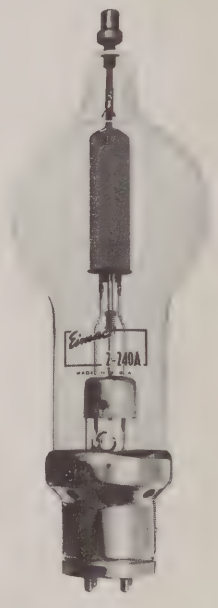
2-240A

HIGH-VACUUM RECTIFIER

The Eimac 2-240A is a high vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 2-240A has a maximum d-c current rating of 500 milliamperes and a maximum peak inverse voltage rating of 25,000 volts. Cooling is by convection and radiation.

A single 2-240A will deliver 320 milliamperes at 10,000 volts to a capacitor-input filter with 9,000 volts single-phase supply. Four 2-240A's in a bridge circuit will deliver 1.0 ampere at 16,000 volts to a choke-input filter with 18,000 volts single-phase supply.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 volts
Current	12.0 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	11.2 inches
Diameter	3.82 inches
Net Weight	10 ounces
Shipping Weight (approx.)	3 pounds

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	25,000 MAX. VOLTS
PLATE DISSIPATION	150 MAX. WATTS
D-C PLATE CURRENT[1]	500 MAX. MA
PEAK PLATE CURRENT	4.0 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 2-240A must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No.123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 2-240A is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-6 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed

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▶ Indicates Change From Sheet Dated 10-31-57

225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 7.5 volts. Variations must be kept within the range from 7.15 to 7.85 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value. All four socket terminals should be used, placing two in parallel for each filament connection.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 2-240A reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage. All four socket terminals should be used, putting two in parallel for each filament connection.

Plate Operation—With low room illumination, the plate of the 2-240A begins to show color as the maximum plate dissipation rating of 150 watts is approached. The maximum peak inverse voltage rating of 25,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 2-240A when used as a power-supply rectifier.

2-240A MAXIMUM-PERFORMANCE CAPABILITIES

Circuit Type	A-C Input Voltage (volts rms)	Capacitor-Input Filter		Choke-Input Filter	
		D-C Output Voltage (volts)	D-C Output Current (amperes)	D-C Output Voltage (volts)	D-C Output Current (amperes)
Single-Phase, Half-Wave	9,000	10,000	0.320	.....	.....
Single-Phase, Full-Wave	9,000[1]	10,000	0.640	8,000	1.00
Single-Phase, Bridge	18,000	20,000	0.640	16,000	1.00

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 2-240A is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 2-240A is 500 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 2-240A is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 2-240A when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifer tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 2-240A, which may be taken as 200 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 2-240A is 25,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 2-240A is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 2-240A is 800 milliamperes.

The plate characteristic curve for the 2-240A serves as a guide to special applications. The maximum plate dissipation rating of 150 watts, the maximum peak inverse voltage rating of 25,000 volts, and the maximum peak plate current of 4.0 amperes must not be exceeded.

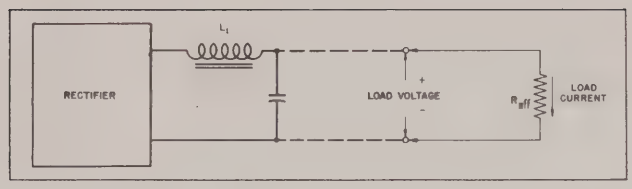
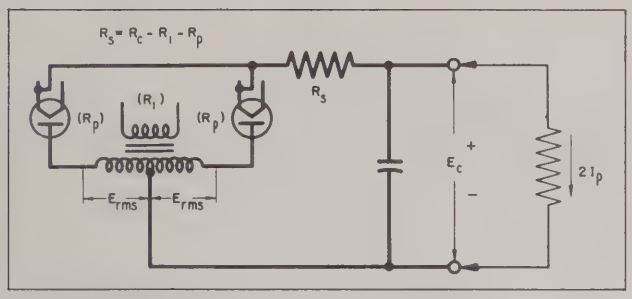
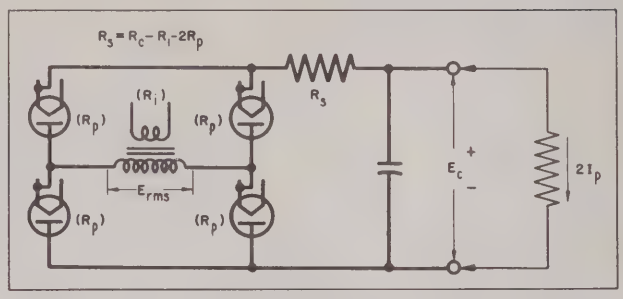


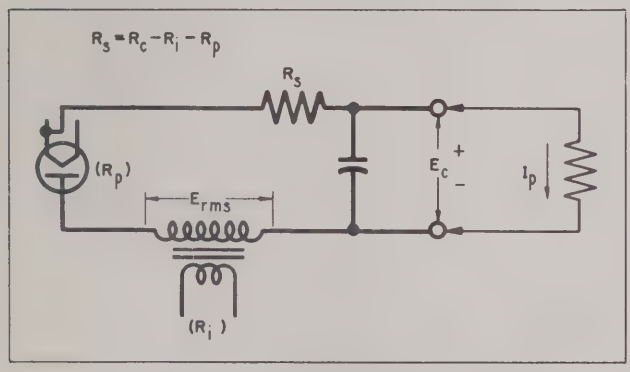
Fig. 1. Rectifier with Choke-Input Filter



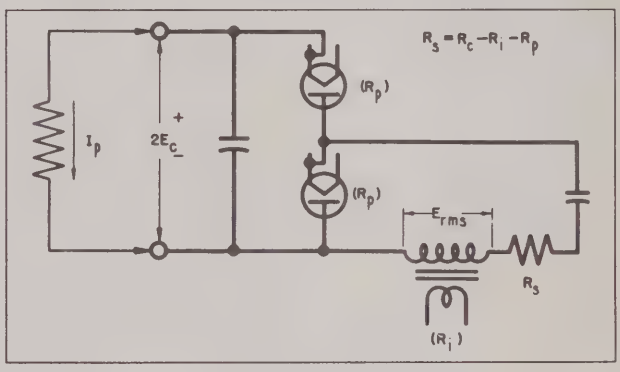
a. Full-Wave Center-Tapped Rectifier



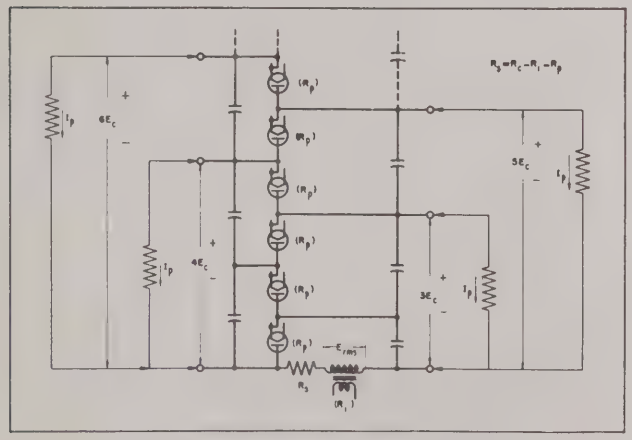
b. Full-Wave Bridge Rectifier



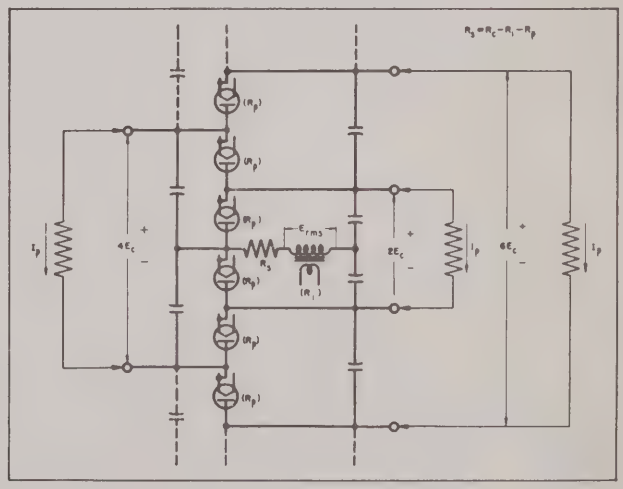
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



f. Full-Wave Voltage Multiplier

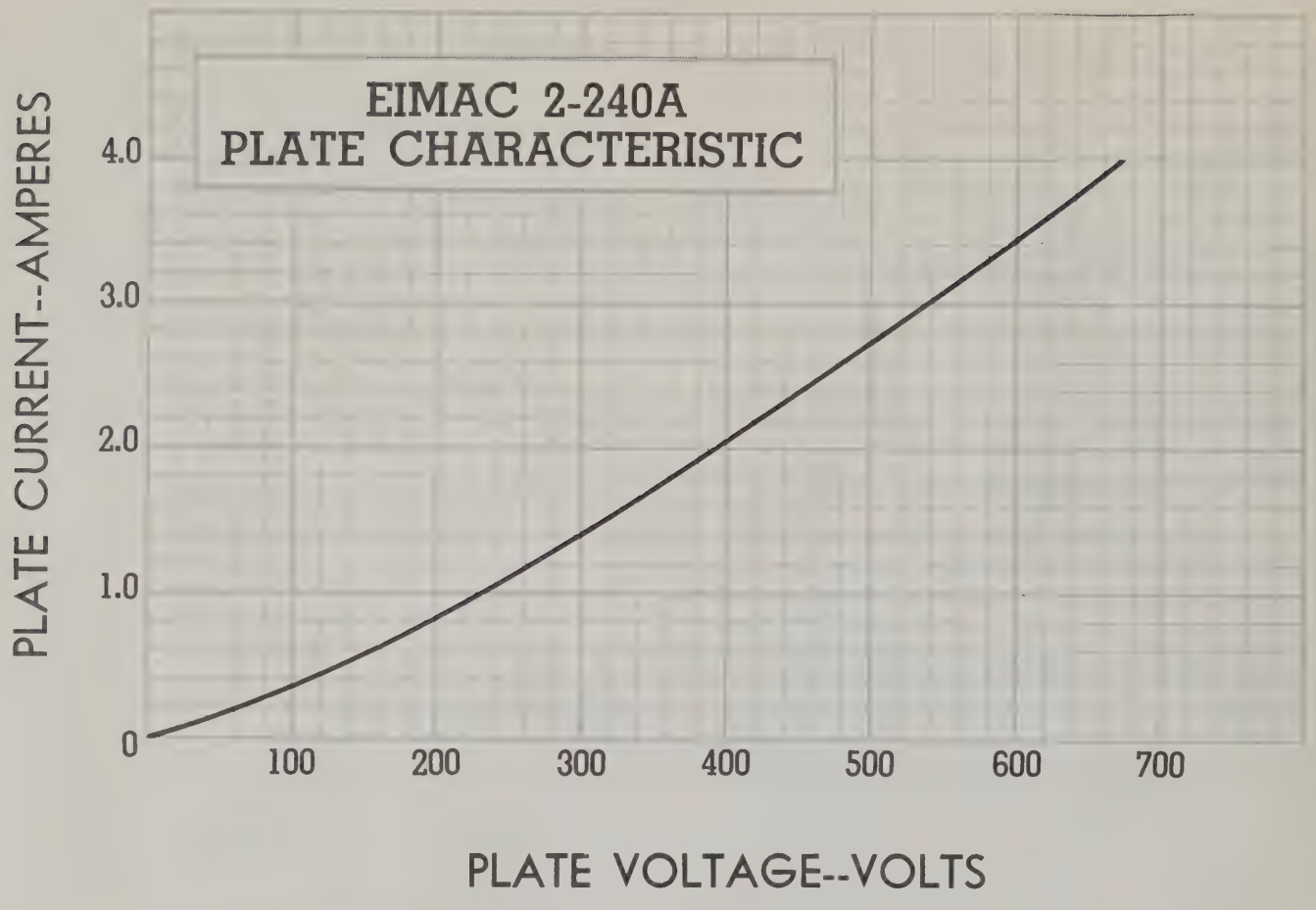
Eimac 2-240A Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	280	300	320	340	360	380	400	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.0	1.8	3.0	5.0	7.5	12	20	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.83	0.87	0.94	1.01	1.14	1.33	times Filter-Input D-C Voltage (E_c)
Peak-Inverse Voltage ($1/2$ these values for circuit b.)	2.3	2.4	2.5	2.7	2.9	3.2	3.8	times Filter-Input D-C Voltage (E_c)

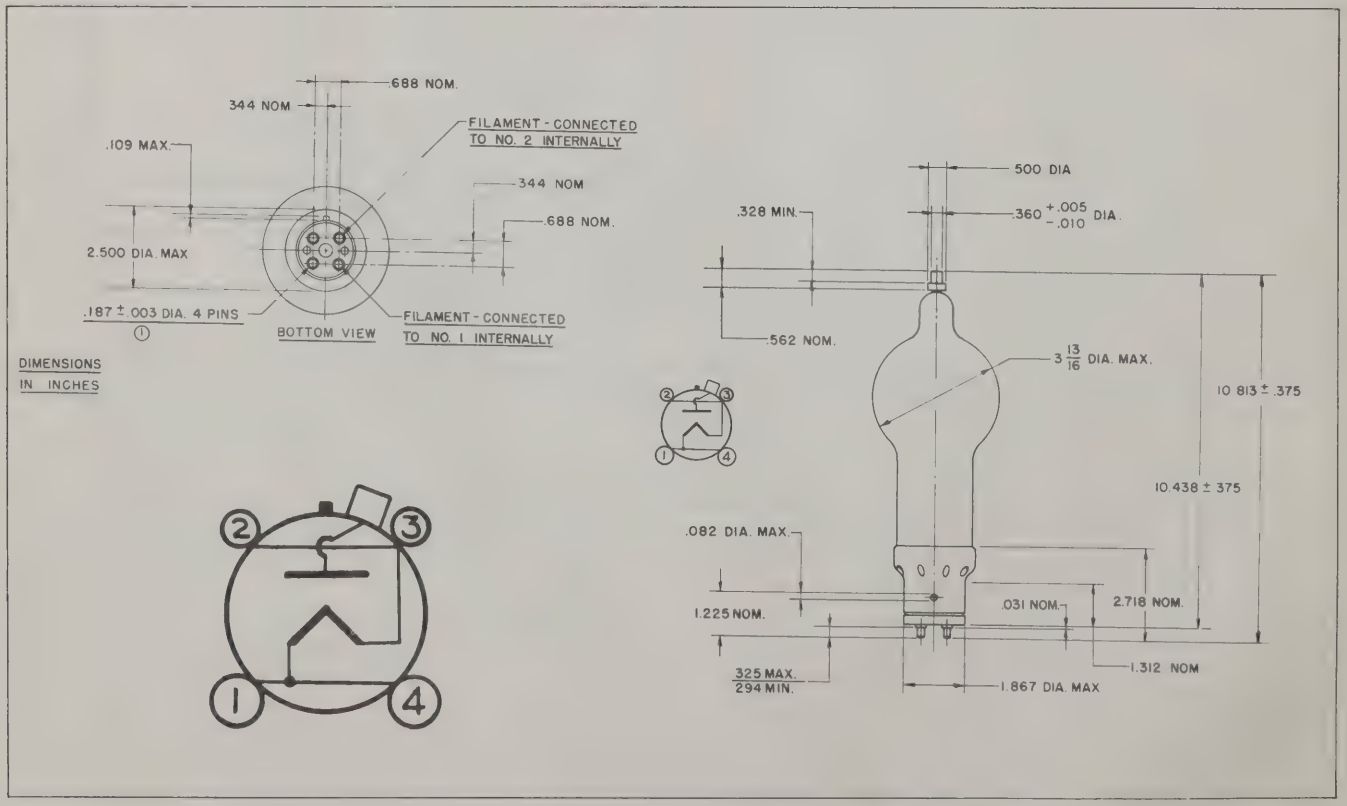
Fig. 2 Eimac 2-240A Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 200 ohms (100 ohms for two tubes in parallel)

EIMAC 2-240A
PLATE CHARACTERISTIC



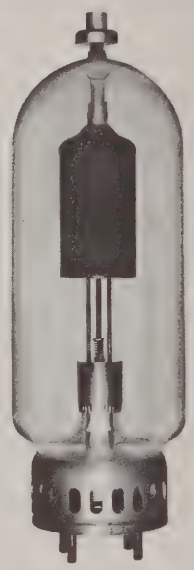


Printed in U.S.A. 82587

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

2-450A
HIGH-VACUUM RECTIFIER



The Eimac 2-450A is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications where high peak-inverse voltages, extreme temperatures, high operating frequency, or the production of high-frequency transients would prevent the use of mercury-vapor or gas-filled rectifier tubes.

CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	25.0		28.0	amperes

MECHANICAL

Base	4-pin, metal shell
Socket	E. F. Johnson Co. 124-214 or equivalent
Operating Position	Vertical, base down or up
Recommended Plate Connector	Eimac HR-8
Maximum Operating Temperatures:	
Plate Seal	225° C
Envelope	250° C
Net Weight	2.4 pounds
Shipping Weight (approximate)	9 pounds

COOLING

The temperature of the plate seal and envelope must not be allowed to exceed 225°C and 250°C respectively. When several tubes are being operated in the same compartment and at or near maximum rated plate dissipation, forced-air cooling is required. In any event, it should be remembered that the listed temperatures are maximums and that lower operating temperatures will result in longer life and improved reliability. The use of a temperature-sensitive paint, sparingly applied in the referenced areas, is recommended to determine the effectiveness of the cooling employed in any given installation.

MAXIMUM RATINGS

▶ Peak Inverse Plate Voltage	30,000 MAX. VOLTS
Plate Dissipation	450 MAX. WATTS
D-C Plate Current	1 MAX. AMPERE
Peak Plate Current	8 MAX. AMPERES

▶ MAXIMUM POWER-SUPPLY CAPABILITIES*

Circuit	Maximum A-C Input Voltage (volts rms)	Approx. D-C Output Voltage (volts)	Maximum D-C Output Current (amps)
Single-Phase, Full-Wave (2 tubes)	21,200 total	9,300	2.0
Single Phase, Bridge (4 tubes)	21,200 total	18,600	2.0
Three-Phase, Full-Wave (6 tubes)	12,250 per leg	28,000	3.0

*Choke-input filter with L equal to or greater than twice "critical"; zero circuit loss assumed; tube drop considered.

CHOKE-INPUT FILTER

The maximum d-c current rating of the 2-450A is 1.0 ampere when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance. This value may be calculated from the appropriate formula below:

$$L_o = \frac{Reff}{18.8f}$$ for full-wave single wave power supplies

$$L_o = \frac{Reff}{75f}$$ for half-wave three-phase power supplies

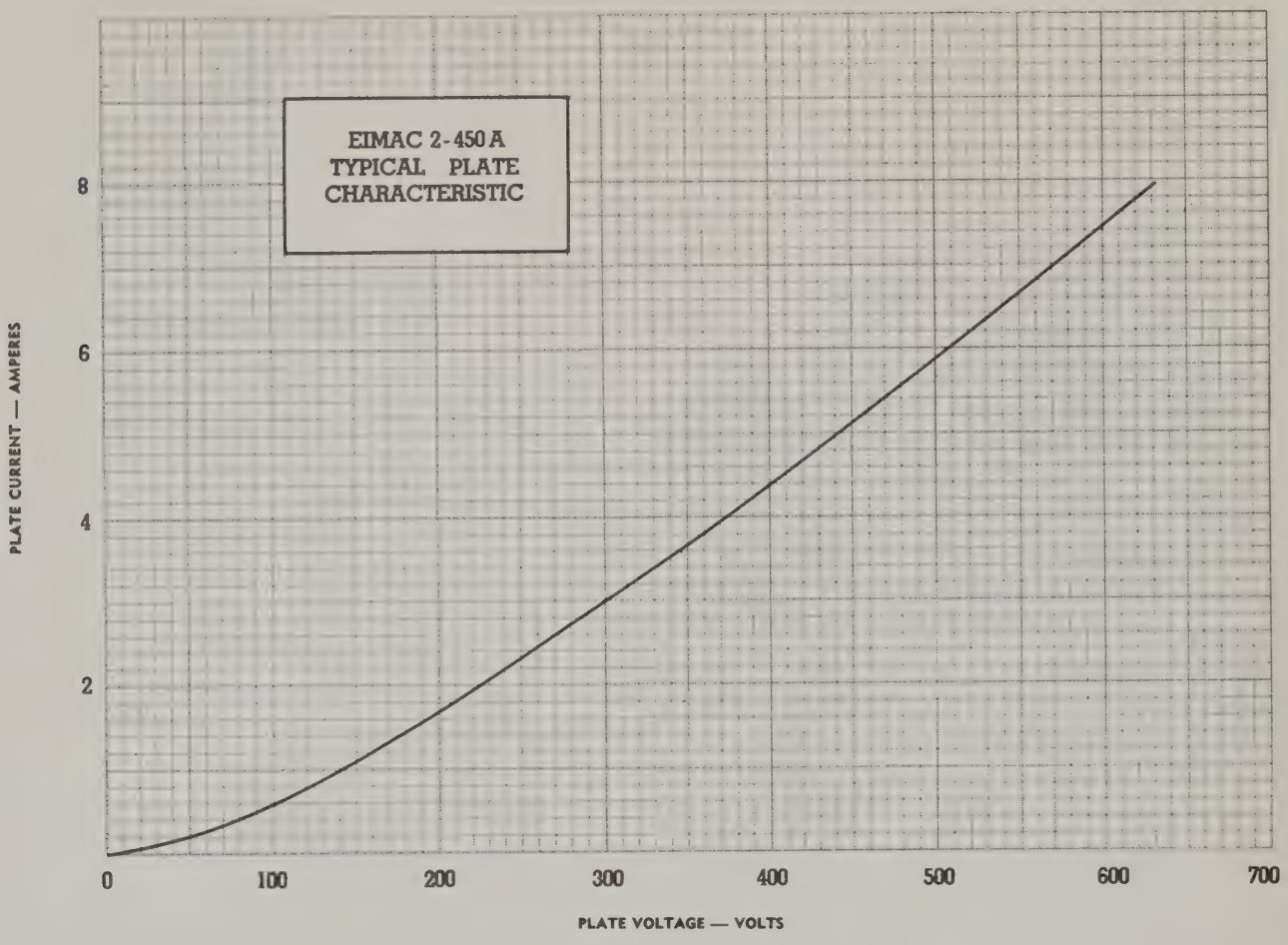
$$L_o = \frac{Reff}{660f}$$ for full-wave three-phase power supplies

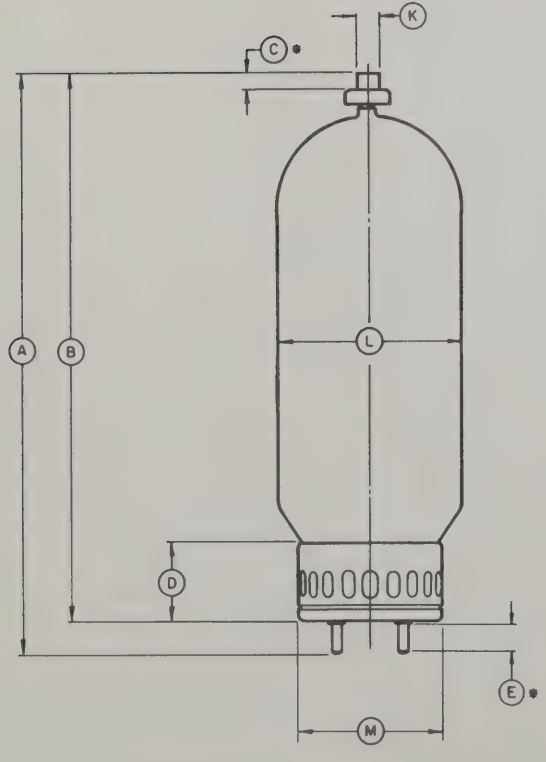
Where: L_o = "critical" value of input inductance (henries)
f = supply-line frequency (cycles per second)

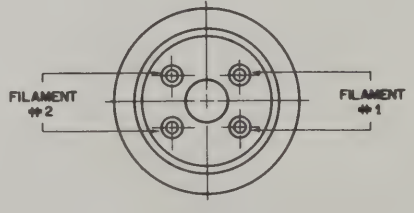
$$Reff = \frac{\text{load voltage (volts)}}{\text{load current (amps)}}$$

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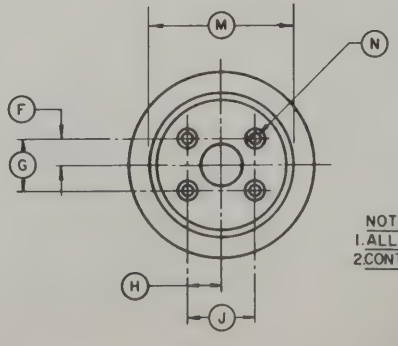
▶ Indicates change from sheet dated 2-13-58







DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		13 1/8	14 1/8
B		12 1/4	13 1/4
C		.445	.465
D	1 3/4		
E		.662	.712
F		.610	.640
G		1.235	1.265
H		.829	.859
J		1.672	1.702
K		.554 DIA.	.566 DIA.
L			4 5/8 DIA.
M			3 5/8 DIA.
N		.245 DIA.	.255 DIA.



NOTES:
1. ALL DIMENSIONS IN INCHES.
2. CONTACT SURFACE (*).

Printed in U.S.A. 82587

Eimac®

EITEL-McCULLOUGH, INC.

2-2000A

HIGH-VACUUM RECTIFIER



The Eimac 2-2000A is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 2-2000A has a maximum d-c current rating of 750 milliamperes and a maximum peak inverse voltage rating of 75,000 volts. Cooling is by forced air, convection, and radiation.

A single 2-2000A will deliver 600 milliamperes at 31,500 volts to a capacitor-input filter with 26,500 volts single-phase supply. Four 2-2000A's in a bridge circuit will deliver 1.50 amperes at 47,600 volts to a choke-input filter with 53,000 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	10.0 volts
Current	25.0 amperes

MECHANICAL

Base	Special 4-pin
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Forced air, convection, and radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-8
Maximum Over-all Dimensions:	
Length	17.8 inches
Diameter	8.13 inches
Net Weight	3 pounds
Shipping Weight (approx.)	13 pounds

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	75,000 MAX. VOLTS
PLATE DISSIPATION	1200 MAX. WATTS
D-C PLATE CURRENT[1]	750 MAX. MA
PEAK PLATE CURRENT	12 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 2-2000A must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The special 4-pin base fits an E. F. Johnson Co. No. 124-214 or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 2-2000A is cooled by forced air, convection, and radiation. Forced air is required for cooling of the filament seals. If an E. F. Johnson Co. No. 124-214 socket is used, air at a static pressure of 4 inches of water measured at the inlet of the ¼-inch cooling tube in the socket will provide sufficient base cooling. The base of the tube is provided with a 1-inch diameter hole. If a socket is used with a 1-inch diameter matching hole and the manifold is of the same diameter, a static pressure of less than 0.1 inch of water will be required. Clearance should be provided around the glass envelope adequate

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APPLICATION (Continued)

for the free circulation of air. An Eimac HR-8 heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St, New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 10.0 volts. Variations must be kept within the range from 9.5 to 10.5 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value. All four socket terminals should be used, putting two in parallel for each filament connection.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 2-2000A reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—The plate of the 2-2000A operates at dull red color at the maximum plate dissipation rating of 1200 watts. The maximum peak-inverse-voltage rating of 75,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 2-2000A when used as a power-supply rectifier.

2-2000A MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voltage (volts)	D-C Output Current (amperes)	D-C Output Voltage (volts)	D-C Output Current (amperes)
Single-Phase, Half-Wave	26,500	31,500	0.600	. . .	. . .
Single-Phase, Full-Wave	26,500[1]	31,500	1.20	23,800	1.50
Single-Phase, Bridge	53,000	63,000	1.20	47,600	1.50

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 2-2000A is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 2-2000A is 750 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 2-2000A is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 2-2000A when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 2-2000A, which may be taken as 400 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak-inverse-voltage rating of the 2-2000A is 75,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 2-2000A is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 2-2000A is 1500 milliamperes.

The plate characteristic curve for the 2-2000A serves as a guide to special applications. The maximum plate dissipation rating of 1200 watts, the maximum peak-inverse-voltage rating of 75,000 volts, and the maximum peak plate current of 12 amperes must not be exceeded.

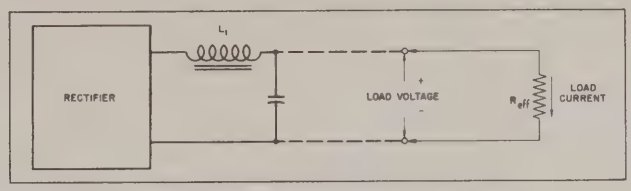
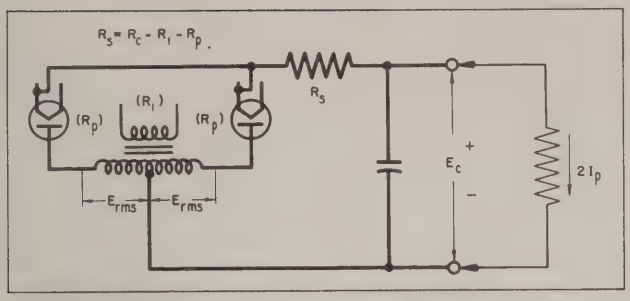
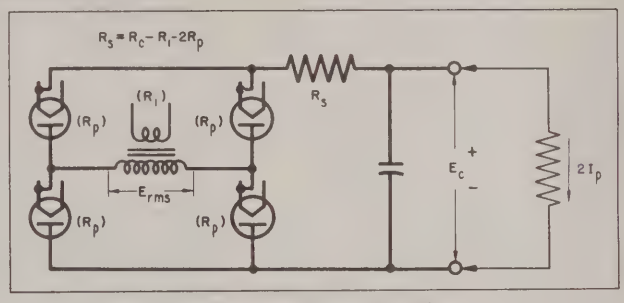


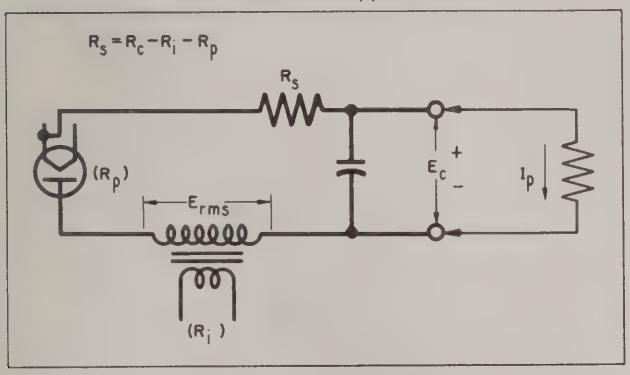
Fig. 1. Rectifier with Choke-Input Filter



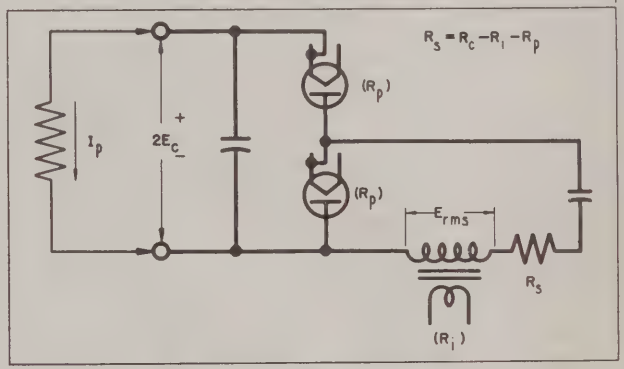
a. Full-Wave Center-Tapped Rectifier



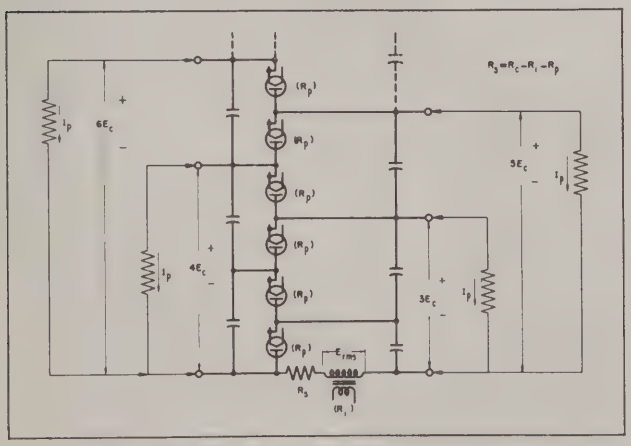
b. Full-Wave Bridge Rectifier



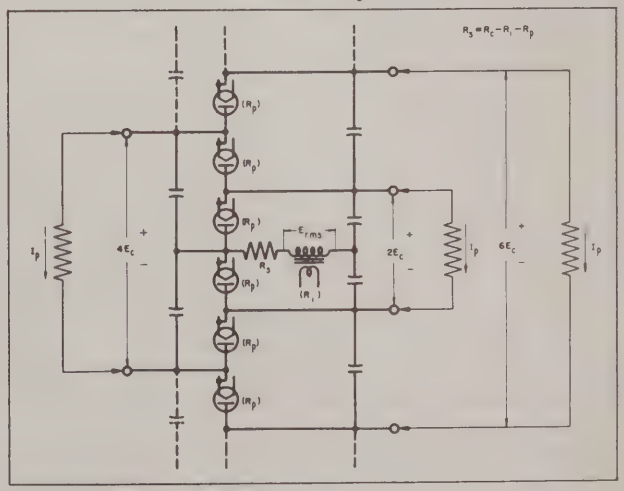
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



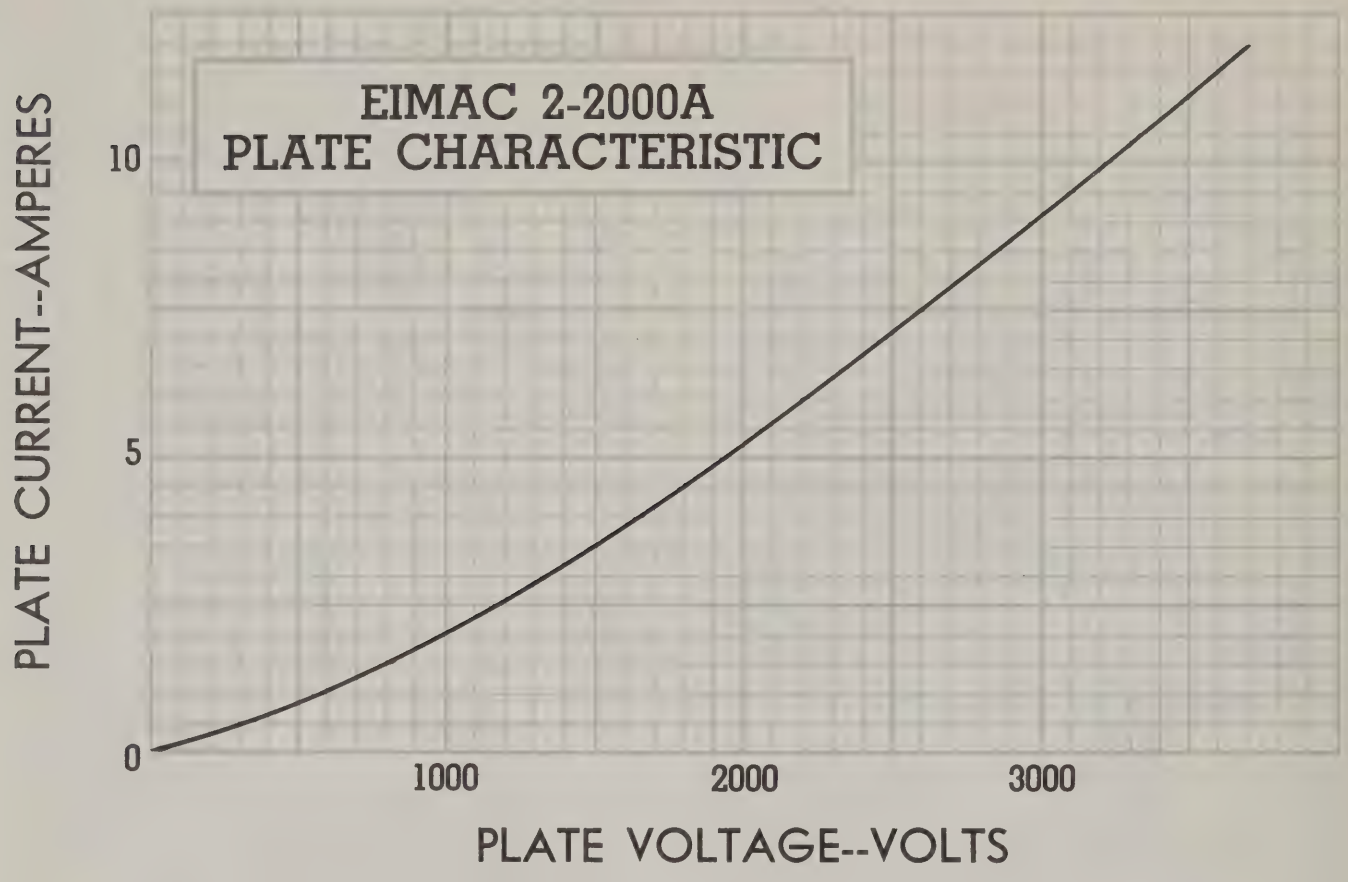
f. Full-Wave Voltage Multiplier

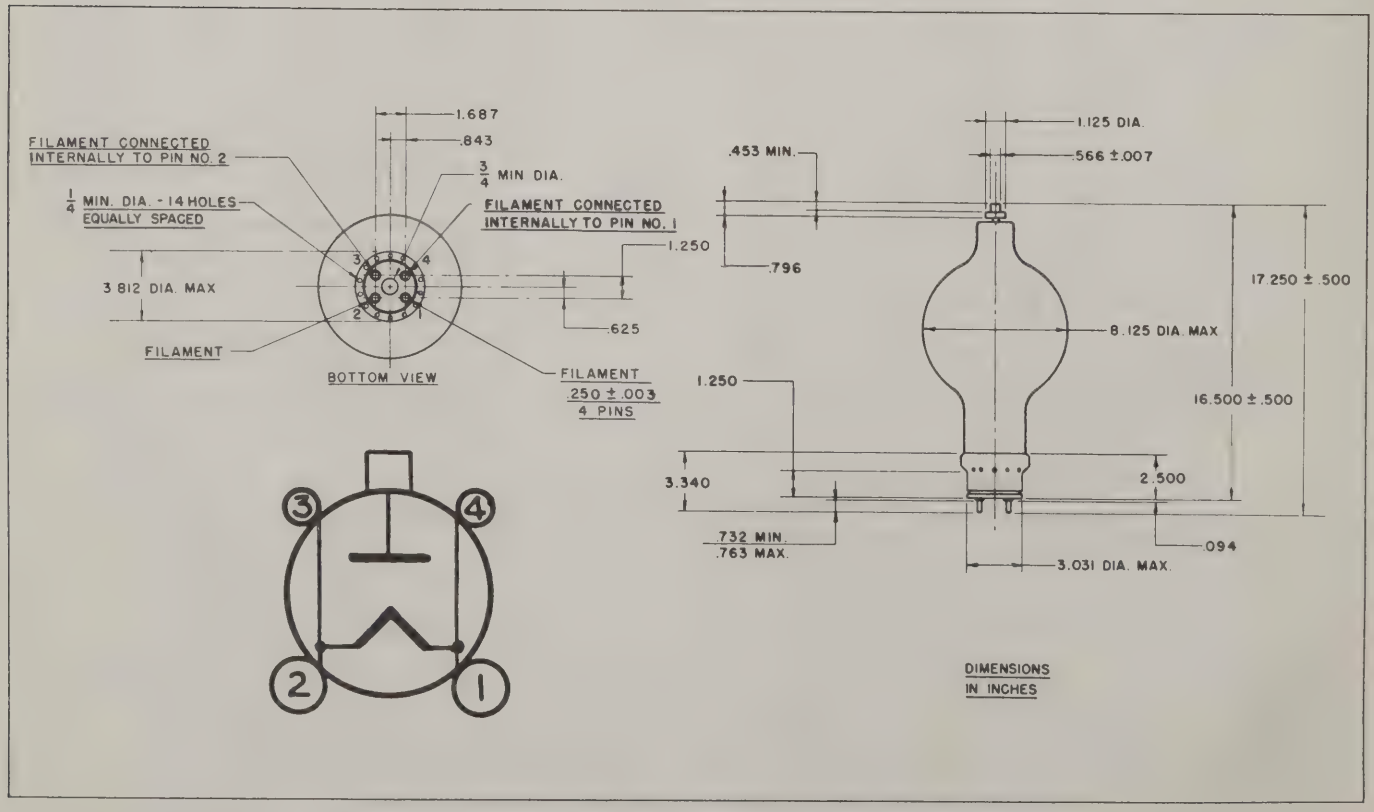
Eimac 2-2000A Maximum D-C Current Ratings for R-C Filter Applications						
D-C Plate Current (I_p)	550	600	650	700	750	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.1	2.1	3.8	7.0	13	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.84	0.90	1.00	1.16	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.3	2.4	2.6	2.8	3.3	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 2-2000A basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 400 ohms (200 ohms for two tubes in parallel)





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Eimac®

EITEL-McCULLOUGH, INC.

2X3000F

HIGH-VACUUM RECTIFIER



The Eimac 2X3000F is a high-vacuum, forced-air cooled, external-anode diode intended for use in high-power rectifier units whenever high peak-inverse voltages, extreme ambient temperatures, high operating frequency, or the production of high-frequency transients would prevent the use of mercury-vapor or gas-filled rectifier tubes.

CHARACTERISTICS

ELECTRICAL

Filament:	Thoriated Tungsten	
Voltage	7.5	volts
Current	51	amperes

MECHANICAL

Operating Position	Vertical, base down or up
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175° C
Anode Core	175° C
Net Weight	5.7 pounds
Shipping Weight (Approximate)	17 pounds

MAXIMUM RATINGS

PEAK INVERSE PLATE VOLTAGE	25,000 MAX. VOLTS
PLATE DISSIPATION	3,000 MAX. WATTS
DC PLATE CURRENT	3 MAX. AMPERES
PEAK PLATE CURRENT	20 MAX. AMPERES

TYPICAL POWER-SUPPLY CAPABILITIES*

Circuit	Maximum AC Input Voltage (volts rms)	Approx. DC Output Voltage (volts)	Maximum DC Output Current (amps)
Single-Phase, Full-Wave (2 tubes)	17,700 total	8,000	6.0
Single-Phase, Bridge (4 tubes)	17,700 total	16,000	6.0
Three-Phase, Full-Wave (6 tubes)	10,200 per leg	24,000	9.0

*Choke-input filter with L equal to or greater than twice "critical"; zero circuit loss assumed.

COOLING

Sufficient forced air cooling must be provided to maintain seal and anode core temperature at 175°C or below. Air-flow must be started when filament power is applied and it is advisable to continue air-cooling for two minutes after all voltages are removed.

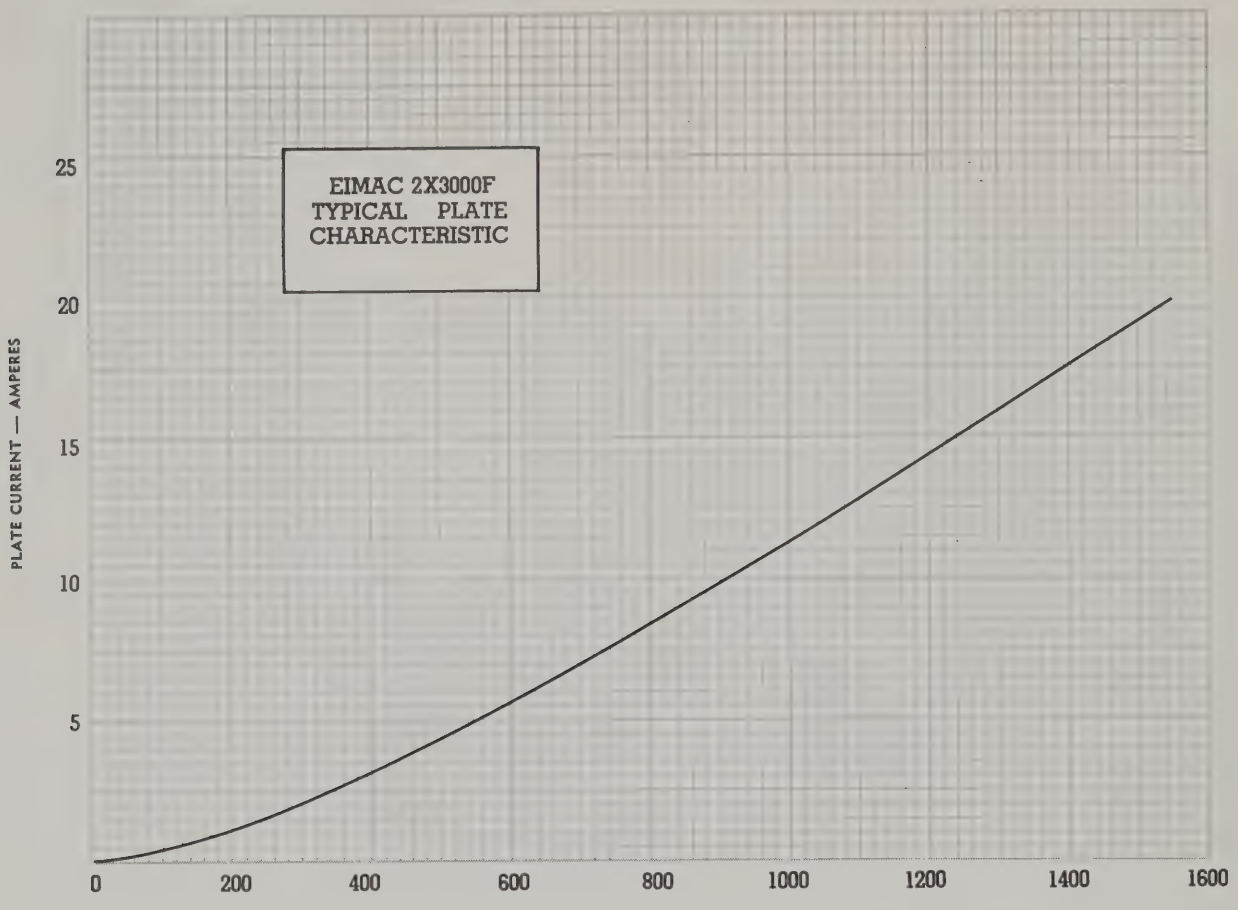
The table below lists minimum air-flow requirements to maintain tube temperatures below 175°C with air flowing in both the base-to-anode and anode-to-base directions. This tabulation presumes air at 40°C and sea level. A separate supply of approximately six cubic feet per minute, directed into the filament structure is also required to maintain rated filament seal temperatures. This is best accomplished using a small diameter insulating tubing directed into the stem, between the filament seals.

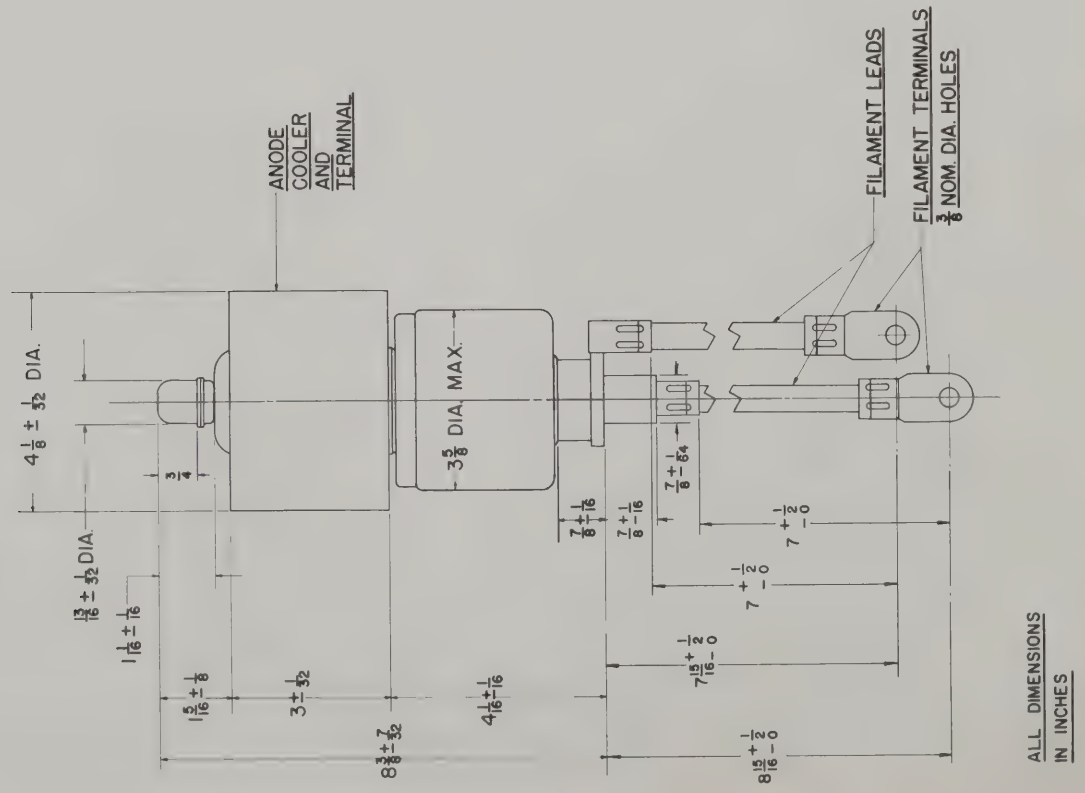
	MINIMUM COOLING AIR-FLOW REQUIREMENTS			
	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)	AIR-FLOW (CFM)	PRESSURE DROP (inches of water)
1000	15	0.1	25	0.2
2000	45	0.4	75	1.2
3000	95	1.4	155	4.5

Note: An extra 375 watts have been added to these plate dissipation figures in preparing this tabulation, to compensate for filament dissipation.

For operation at high altitudes or higher ambient temperatures, these quantities should be increased. In all cases it is suggested that actual temperatures be measured to insure adequate cooling.

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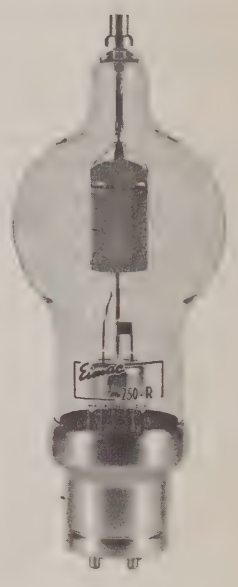


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EITEL-McCULLOUGH, INC.

250R

HIGH-VACUUM RECTIFIER



The Eimac 250R is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 250R has a maximum d-c current rating of 250 milliamperes and a maximum peak inverse voltage rating of 60,000 volts. Cooling is by convection and radiation.

A single 250R will deliver 160 milliamperes at 24,000 volts to a capacitor-input filter with 21,000 volts single-phase supply. Four 250R's in a bridge circuit will deliver 500 milliamperes at 38,000 volts to a choke-input filter with 42,000 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	10.5 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and Radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	10.13 inches
Diameter	3.82 inches
Net Weight	10 ounces
Shipping Weight (approx.)	3 pounds

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	60,000 MAX. VOLTS
PLATE DISSIPATION	150 MAX. WATTS
D-C PLATE CURRENT[1]	250 MAX. MA
PEAK PLATE CURRENT	2.5 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 250R must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 250R is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-6 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed

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225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 250R reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 250R begins to show color as the maximum plate dissipation rating of 150 watts is approached. The maximum peak inverse voltage rating of 60,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 250R when used as a power-supply rectifier.

250R MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voltage (volts)	D-C Output Current (ma)	D-C Output Voltage (volts)	D-C Output Current (ma)
Single-Phase, Half-Wave	21,000	24,000	160	. .	.
Single-Phase, Full-Wave	21,000[1]	24,000	320	19,000	500
Single-Phase, Bridge	42,000	48,000	320	38,000	500

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 250R is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 250R is 250 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),
$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}$.

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 250R is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 250R when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 250R, which may be taken as 750 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply experssed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 250R is 60,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 250R is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 250R is 400 milliamperes.

The plate characteristic curve for the 250R serves as a guide to special applications. The maximum plate dissipation rating of 150 watts, the maximum peak inverse voltage rating of 60,000 volts, and the maximum peak plate current of 2.5 amperes must not be exceeded.

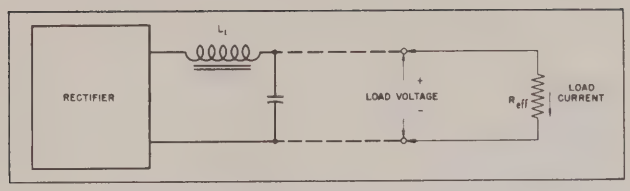
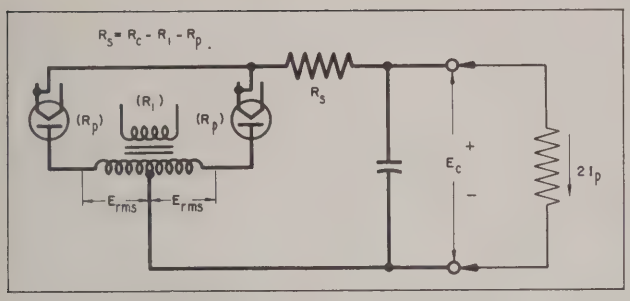
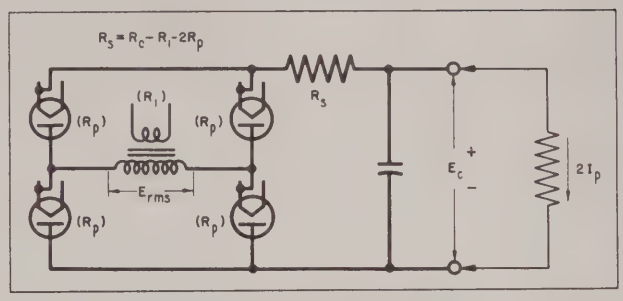


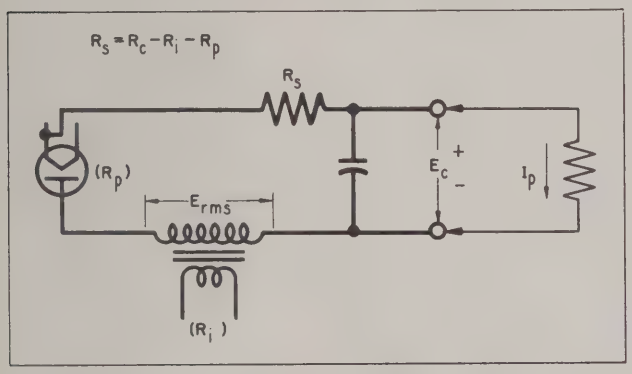
Fig. 1. Rectifier with Choke-Input Filter



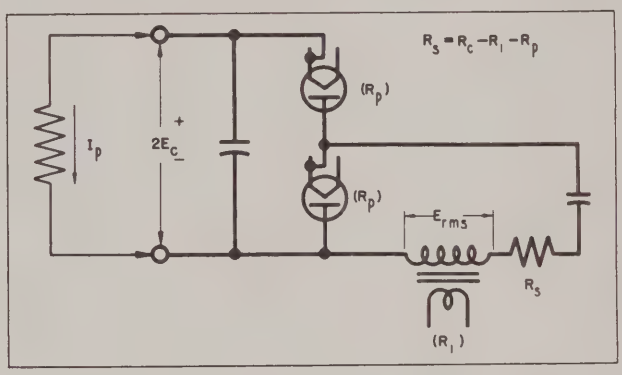
a. Full-Wave Center-Tapped Rectifier



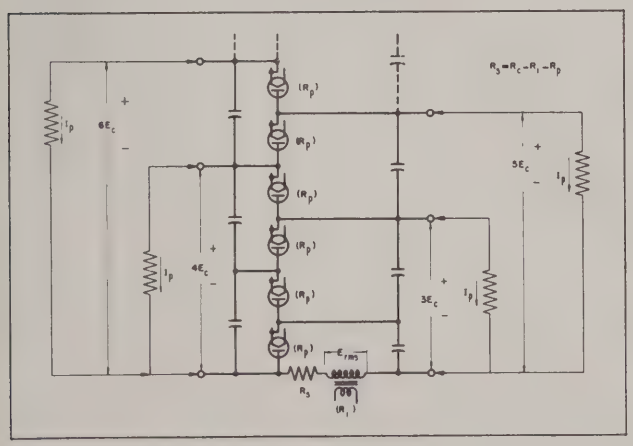
b. Full-Wave Bridge Rectifier



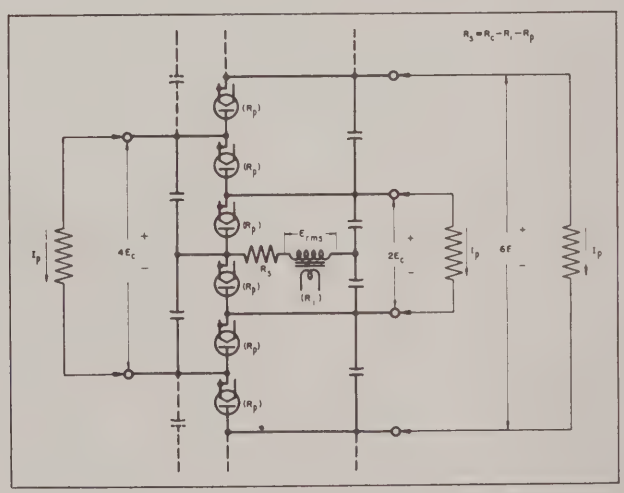
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



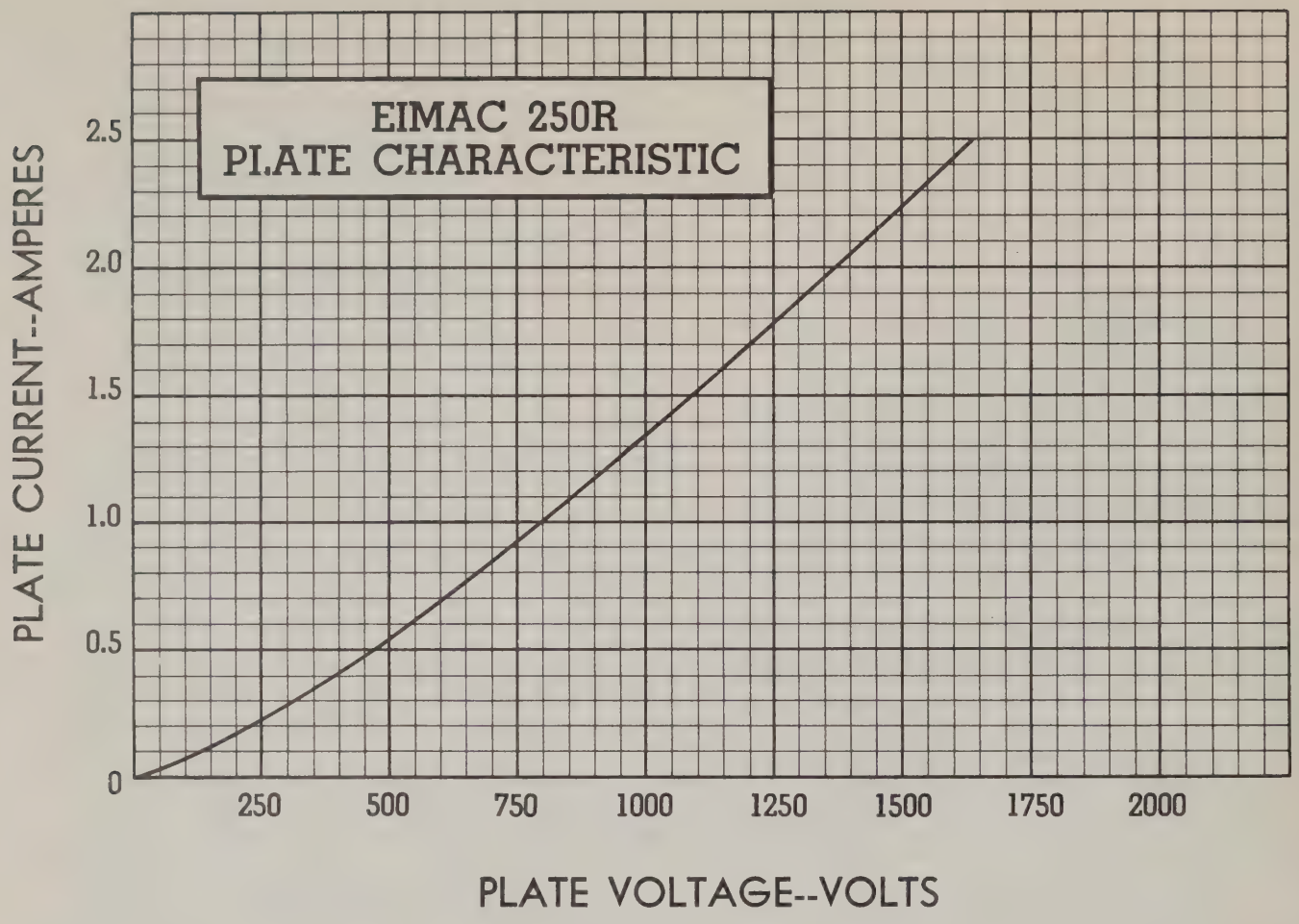
f. Full-Wave Voltage Multiplier

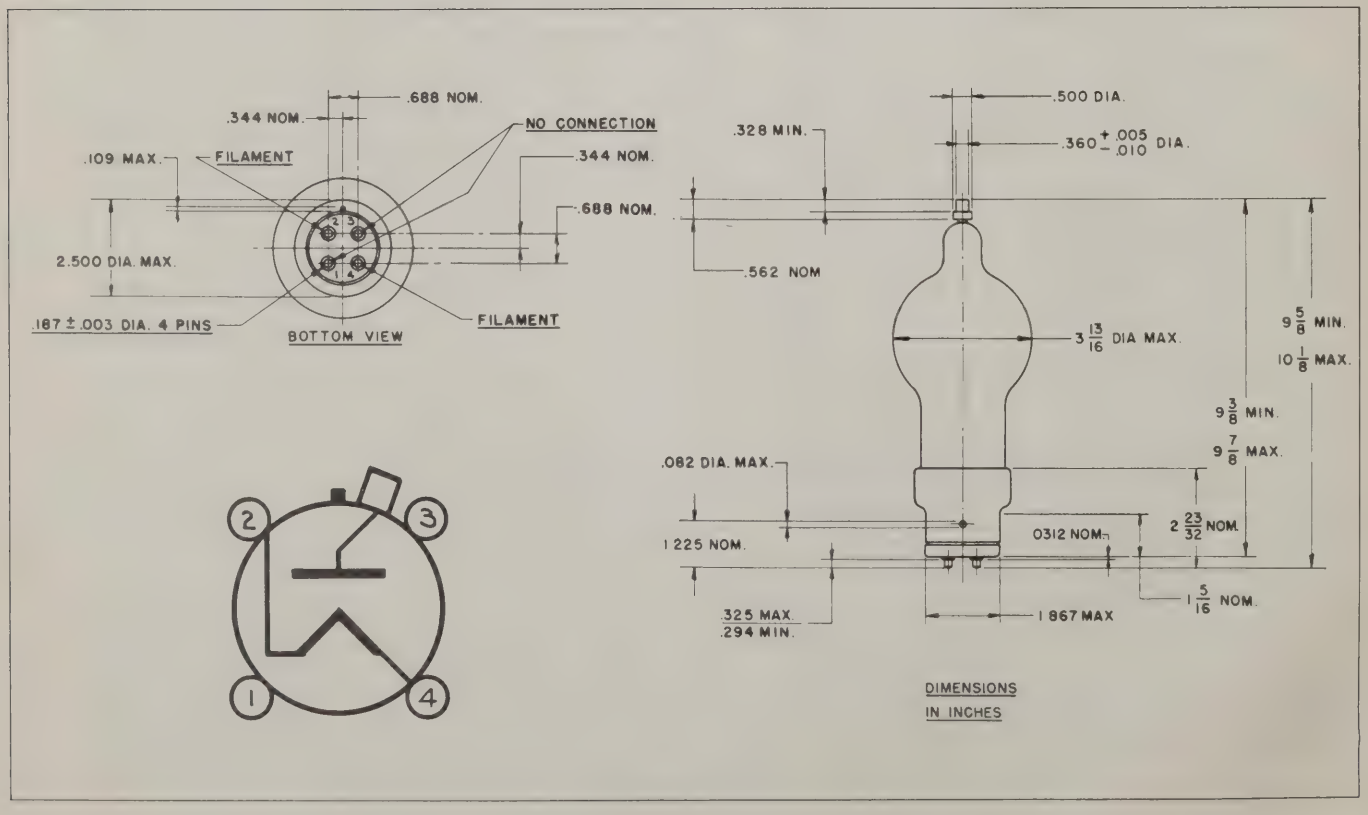
Eimac 250R Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	140	150	160	170	180	190	200	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.2	1.9	3.0	4.8	7.6	12	19	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.83	0.87	0.93	1.01	1.14	1.33	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.3	2.4	2.5	2.7	2.9	3.2	3.7	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 250R Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 750 ohms (375 ohms for two tubes in parallel)

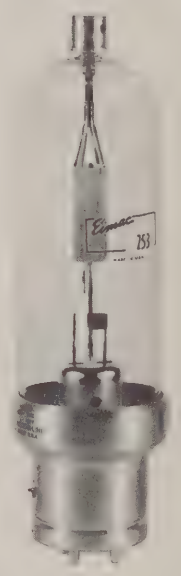




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253

HIGH-VACUUM RECTIFIER



The Eimac 253 is a high-vacuum diode rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 253 has a maximum d-c current rating of 350 milliamperes and a maximum peak inverse voltage rating of 15,000 volts. Cooling is by convection and radiation.

A single 253 will deliver 210 milliamperes at 5640 volts to a capacitor-input filter with 5300 volts single-phase supply. Four 253's in a bridge circuit will deliver 700 milliamperes at 9500 volts to a choke-input filter with 10,600 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	10.0 amperes

MECHANICAL

Base	50-watt jumbo 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and Radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-8
Maximum Over-all Dimensions:	
Length	8.75 inches
Diameter	2.50 inches
Net Weight	7 ounces
Shipping Weight (approx.)	1 pound

MAXIMUM RATINGS (Per Tube)

PEAK INVERSE PLATE VOLTAGE	15,000 MAX. VOLTS
PLATE DISSIPATION	100 MAX. WATTS
D-C PLATE CURRENT[1]	350 MAX. MA
PEAK PLATE CURRENT	2.5 MAX. AMPERES

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 253 must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The 50-watt jumbo 4-pin bayonet base fits an E. F. Johnson Co. No. 123-211, a National Co. No. XM-50, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 253 is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-8 Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this tem-

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perature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd Street, New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

CAUTION SHOULD BE OBSERVED WHEN MEASURING RECTIFIER FILAMENT VOLTAGE. THE FILAMENT CIRCUIT MAY BE AT HIGH POTENTIAL.

The thoriated-tungsten filament of the 253 reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 253 begins to show color as the maximum plate dissipation rating of 100 watts is approached. The maximum peak inverse voltage rating of 15,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 253 when used as a power-supply rectifier.

253 MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voltage (volts)	D-C Output Current (ma)	D-C Output Voltage (volts)	D-C Output Current (ma)
Single-Phase, Half-Wave	5300	5640	210	.....	.....
Single-Phase, Full-Wave	5300[1]	5640	420	4750	700
Single-Phase, Bridge	10,600	11,280	420	9500	700

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 253 is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter–The maximum d-c current rating of the 253 is 350 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_f in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),
f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 253 is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 253 when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube (E_c/I_p). The total charging-circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_i.

R_p is the plate resistance of the 253, which may be taken as 300 ohms.

R_i is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 253 is 15,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- and full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications–The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable, and filter capacitance is low, the 253 is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 253 is 500 milliamperes.

The plate characteristic curve for the 253 serves as a guide to special applications. The maximum plate dissipation rating of 100 watts, the maximum peak inverse voltage rating of 15,000 volts, and the maximum peak plate current of 2.5 amperes must not be exceeded.

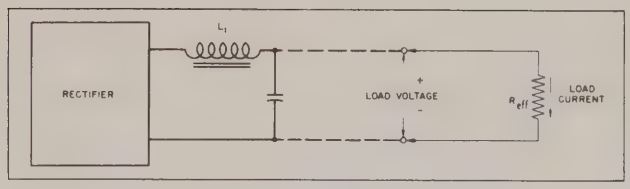
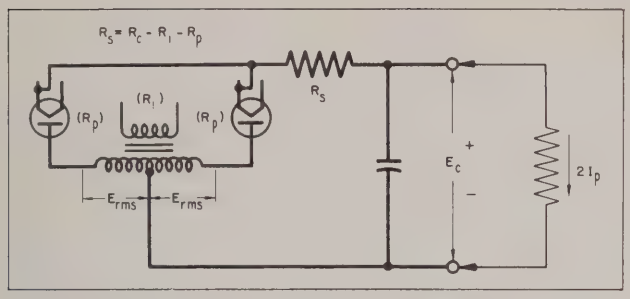
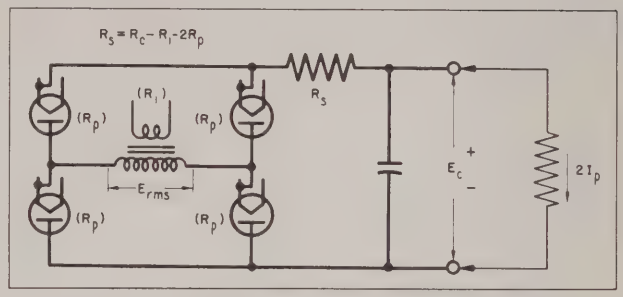


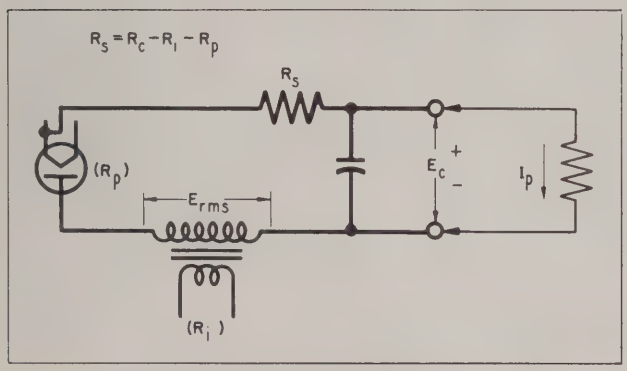
Fig. 1. Rectifier with Choke-Input Filter



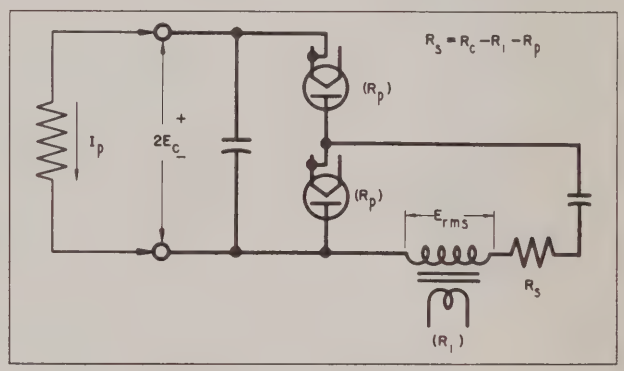
a. Full-Wave Center-Tapped Rectifier



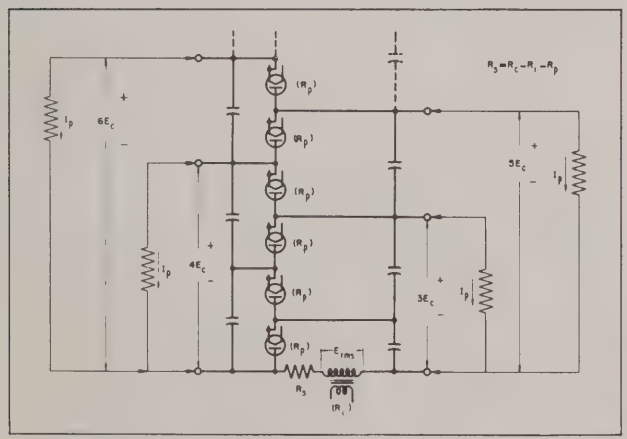
b. Full-Wave Bridge Rectifier



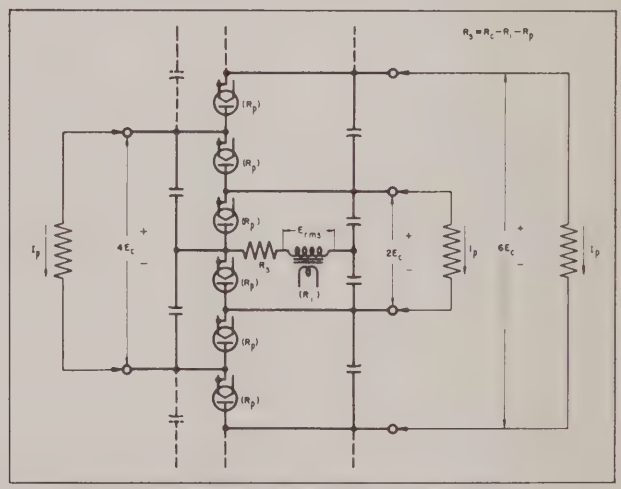
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})



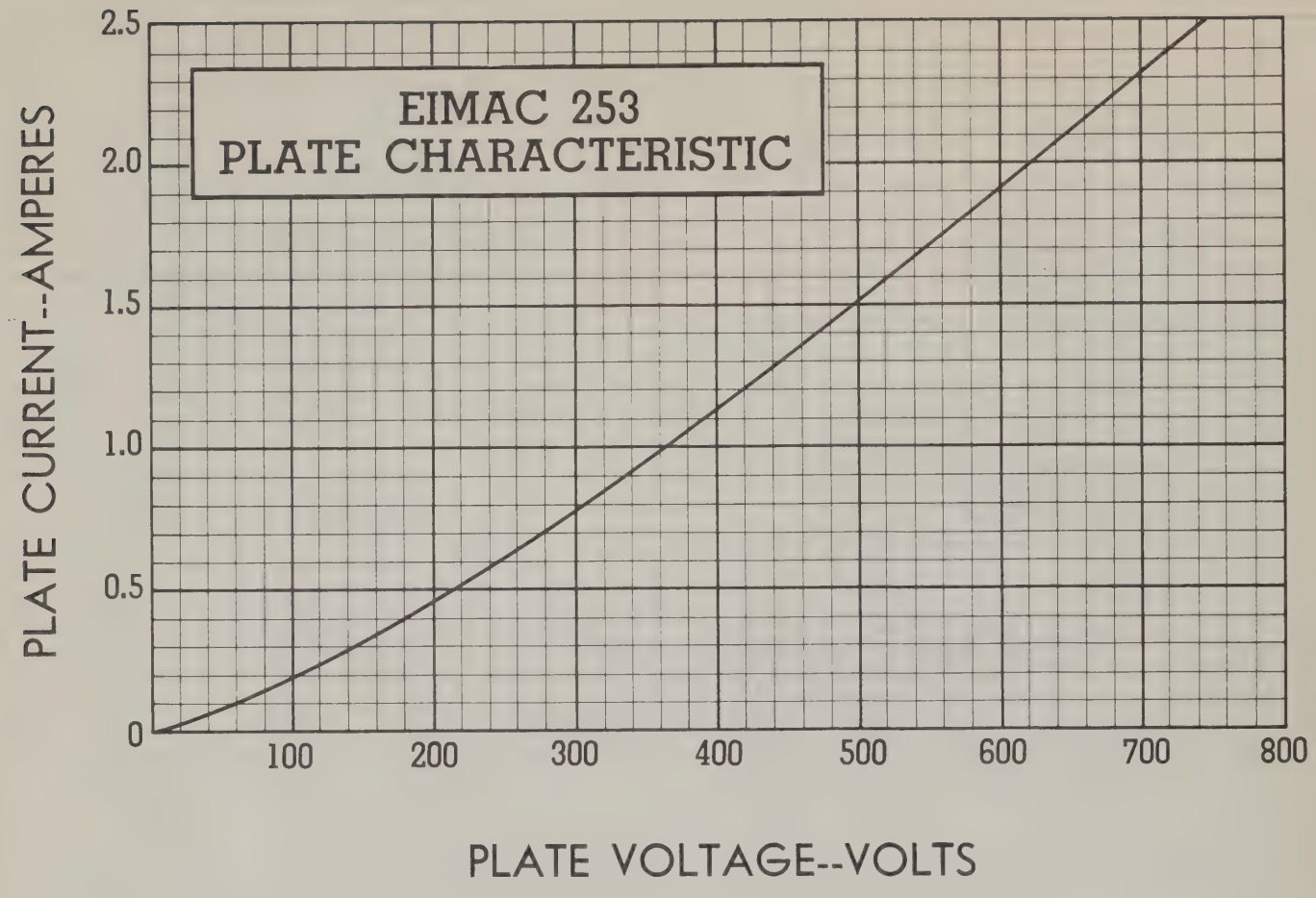
f. Full-Wave Voltage Multiplier

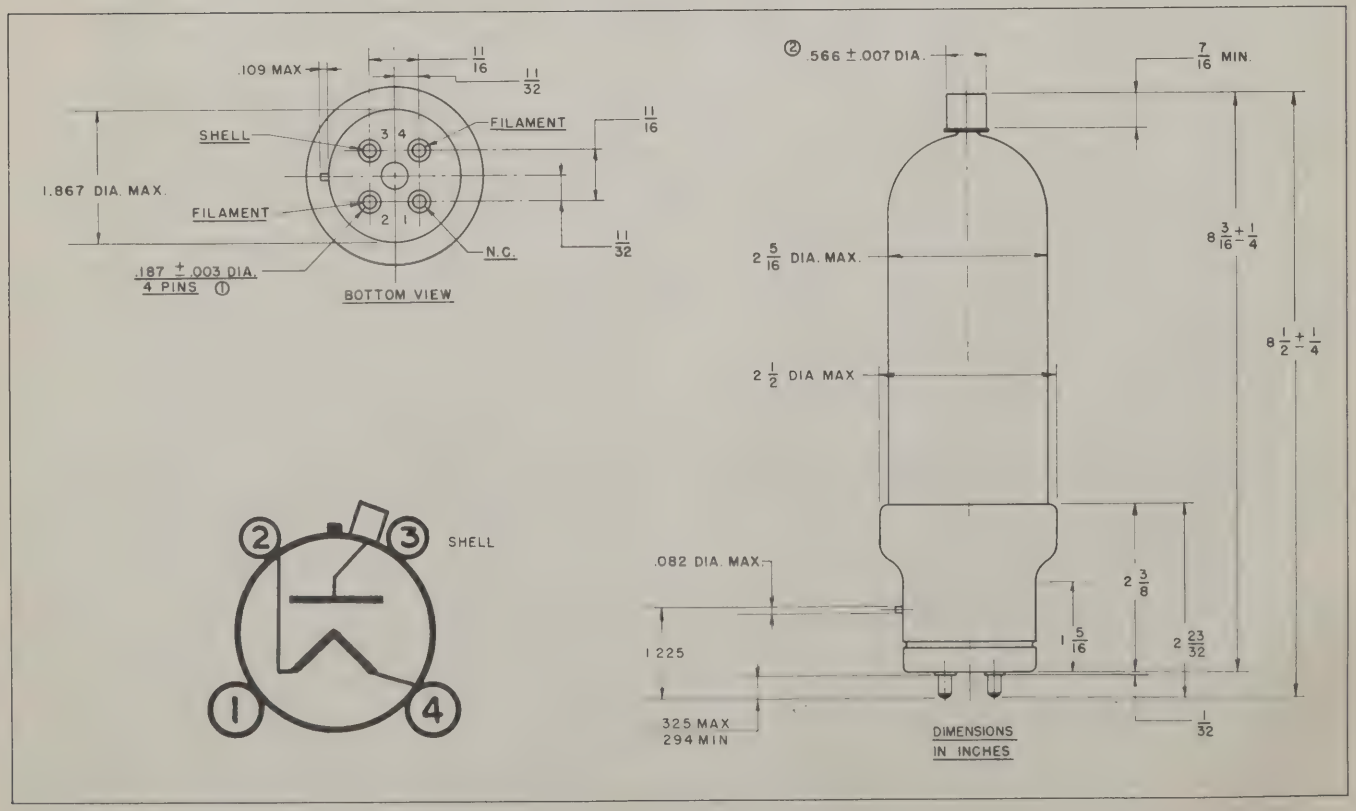
Eimac 253 Maximum D-C Current Ratings for R-C Filter Applications						
D-C Plate Current (I_p)	170	190	210	230	250	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	1.1	2.3	5.0	10	27	percent of Effective Load Resistance per Tube (E_c/I_p)
A-C Supply Voltage (E_{rms})	0.80	0.85	0.94	1.08	1.50	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values for circuit b.)	2.3	2.4	2.7	3.1	4.3	times Filter-Input D-C Voltage (E_c)

Fig. 2 Eimac 253 Basic R-C Circuits (for any one of the indicated loads)

R_i = Equivalent resistance of voltage source

R_p = 300 ohms (150 ohms for two tubes in parallel)



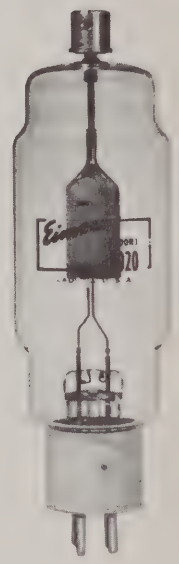


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Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

8020
(100R)
HIGH-VACUUM RECTIFIER



The Eimac 8020(100R) diode is a high-vacuum rectifier intended for use in rectifier units, voltage multipliers, or in special applications, whenever conditions of extreme ambient temperatures, high operating frequency, high peak inverse voltages, or the production of high-frequency transients would prevent the use of gas-filled rectifier tubes.

The 8020 has a maximum d-c current rating of 100 milliamperes and a maximum peak inverse voltage rating of 40,000 volts. Cooling is by convection and radiation.

A single 8020 will deliver 80 milliamperes at 17,000 volts to a capacitor-input filter with 14,000 volts single-phase supply. Four 8020's in a bridge circuit will deliver 200 milliamperes at 25,000 volts to a choke-input filter with 28,000 volts single-phase supply.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	6.5 amperes

MECHANICAL

Base	Medium 4-pin bayonet
Basing	Refer to outline drawing
Socket	Refer to discussion under "Application"
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Maximum Temperature of Plate Seal	225°C
Recommended Heat Dissipating Plate Connector	Eimac HR-8
Maximum Overall Dimensions:	
Length	8.00 inches
Diameter	2.32 inches
Net Weight	4 ounces
Shipping Weight (approx.)	1 pound

MAXIMUM RATINGS (Per tube)

PEAK INVERSE PLATE VOLTAGE	40,000 MAX. VOLTS
PLATE DISSIPATION	60 MAX. WATTS
D-C PLATE CURRENT[1]	100 MAX. MA
PEAK PLATE CURRENT	1.5 MAX. AMPERE

[1]Averaged over one cycle for each tube. Applies only when the rectifier is coupled to the load by a choke-input filter incorporating the "critical" value (or larger) of input inductance. For maximum d-c current ratings under this and other load conditions see discussion under "Application".

APPLICATION

MECHANICAL

Mounting—The 8020 must be mounted vertically with the base either down or up. The lead to the plate terminal of the tube should be flexible.

The medium 4-pin bayonet base fits an E. F. Johnson Co. No. 122-224, a National Co. No. XC-4 or CIR-4, or an equivalent socket. In some circuits, particularly those of the voltage multipliers illustrated in Fig. 2, it may be necessary to mount the socket on stand-off insulators, or on a sheet of insulating material, to provide adequate insulation to ground.

Cooling—The 8020 is cooled by convection and radiation. Clearance should be provided around the glass envelope adequate for the free circulation of air. An Eimac HR-8

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APPLICATION (Continued)

Heat Dissipating Connector or equivalent is required on the plate terminal.

The maximum temperature at the plate seal must not exceed 225°C. A convenient accessory for measuring this temperature is "Tempilaq", a temperature-sensitive lacquer available from the Tempil Corporation, 132 W. 22nd St., New York 11, N. Y.

ELECTRICAL

Filament Operation—For maximum tube life, the filament voltage, as measured at the base pins, should be the rated value of 5.0 volts. Variations must be kept within the range from 4.75 to 5.25 volts. In applications which require the diode to deliver high peak currents, it is important to maintain the filament voltage at the rated value.

Caution should be observed when measuring rectifier filament voltage. The filament circuit may be at high potential.

The thoriated-tungsten filament of the 8020 reaches operating temperature in a fraction of a second after application of voltage. Plate voltage may be applied simultaneously with filament voltage.

Plate Operation—With low room illumination, the plate of the 8020 begins to show color as the maximum plate dissipation rating of 60 watts is approached. The maximum peak inverse voltage rating of 40,000 volts should not be exceeded at any time.

Performance—The accompanying table shows some maximum performance capabilities of the 8020 when used as a power-supply rectifier.

8020 MAXIMUM-PERFORMANCE CAPABILITIES

		Capacitor-Input Filter		Choke-Input Filter	
Circuit Type	A-C Input Voltage (volts rms)	D-C Output Voltage (volts)	D-C Output Current (ma)	D-C Output Voltage (volts)	D-C Output Current (ma)
Single-Phase, Half-Wave	14,000	17,000	80	—	—
Single-Phase, Full-Wave	14,000[1]	17,000	160	12,500	200
Single-Phase, Bridge	28,000	34,000	160	25,000	200

[1]One-half the transformer secondary voltage.

Maximum D-C Current Ratings—Plate dissipation rather than peak current usually limits the d-c current which the 8020 is capable of delivering to the load. Because the plate dissipation associated with a given d-c current depends upon the amount of ripple and its wave-shape, circuit conditions will determine the maximum d-c current rating of the tube.

Choke-Input Filter—The maximum d-c current rating of the 8020 is 100 milliamperes when the load incorporates a choke-input filter with the "critical" value (or larger) of input inductance (L_1 in Fig. 1):

$$L_o = \frac{R_{eff}}{18.8f} \quad \text{for full-wave single-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{75f} \quad \text{for half-wave three-phase rectifiers,}$$

$$L_o = \frac{R_{eff}}{660f} \quad \text{for full-wave three-phase rectifiers,}$$

where: L_o = "critical" value of input inductance (henries),

f = supply-line frequency (cycles per second),

$$R_{eff} = \frac{\text{Load voltage (volts)}}{\text{Load current (amps)}}.$$

Choke-input filters are not normally used with single-phase half-wave rectifiers.

Capacitor-Input Filter—The 8020 is particularly suitable for power-supply applications demanding high voltage at low current. Under these conditions capacitor-input filter circuits become desirable. The maximum d-c current rating of the 8020 when no input choke is incorporated in the filter depends upon the total series resistance of the capacitor-charging circuit relative to the effective load resistance seen by each tube. The circuit diagrams and tabulation in Fig. 2 are so arranged and labeled that this required series resistance may be found for a wide range of load conditions. This may be done by determining the value of the following quantities:

E_c is the filter-input d-c voltage. While this is usually the entire load voltage, in the case of voltage multipliers it is the load voltage divided by the multiplication factor.

I_p is the d-c current per tube. This is the entire load current only in the case of the simple half-wave rectifier or half- or full-wave multiplier. In the case of full-wave center-tapped or bridge rectifiers, I_p is half the load current.

R_c is the total charging-circuit resistance. A certain minimum value of charging-circuit resistance is necessary to limit the peak value of current to which the tubes will be subjected under given load conditions. This required minimum depends upon the d-c current per tube (I_p), and has been tabulated in Fig. 2 as a percentage of the effective load resistance per tube $\left(\frac{E_c}{I_p}\right)$. The total charging circuit resistance involves the internal resistance of the rectifier tube, R_p, the added series resistor, R_s, and the equivalent internal resistance of the a-c voltage supply, R_l.

R_p is the plate resistance of the 8020, which may be taken as 1000 ohms.

R_l is the equivalent internal resistance of the supply. This may be taken as the regulation of the high-voltage supply expressed as a decimal multiplied by the load resistance used in measuring this regulation.

R_s is the series resistor which must be inserted in the charging circuit to bring the total charging-circuit resistance up to the required minimum. Its value may be found from the formula associated with each of the circuits of Fig. 2. This resistor must be inserted in such a position in the circuit that it protects all tubes.

Tubes may be operated in parallel to increase the output capability in a given circuit. When two tubes are placed in parallel at each place where one is shown in the circuits of Fig. 2, the plate resistance (R_p) will be half as great and the maximum allowable load current twice as great as indicated.

Peak Inverse Voltage—The peak inverse voltage rating of the 8020 is 40,000 volts. In single-phase power-supply rectifier circuits the peak inverse voltage to be used in design is the peak a-c supply voltage (1.41 times E_{rms} in Fig. 2) in the case of bridge circuits, and twice this value in the case of half- or full-wave rectifiers and voltage multipliers. Peak inverse voltage in three-phase operation depends upon the circuit employed, and will be found listed in the handbooks.

Special Applications—The ratings given for capacitor-input filter circuits assume values of input capacitance large enough to hold the ripple to a low value. In special applications where a larger percent ripple is tolerable and filter capacitance is low, the 8020 is capable of larger d-c output currents.

As a unidirectional conductor in d-c circuits where the current is continuous and the percent ripple is moderate, the maximum current rating of the 8020 is 200 milliamperes.

The plate characteristic curve for the 8020 serves as a guide to special applications. The maximum plate dissipation rating of 60 watts, the maximum peak inverse voltage rating of 40,000 volts, and the maximum peak plate current of 1.5 ampere must not be exceeded.

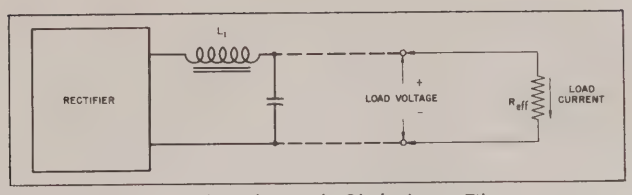
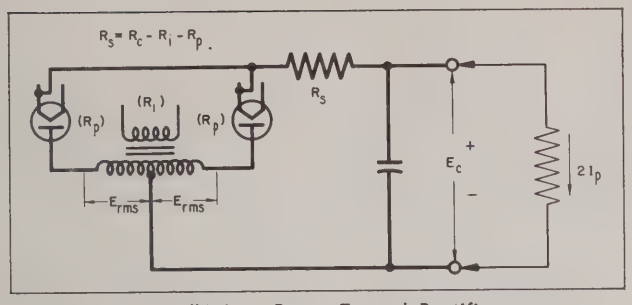
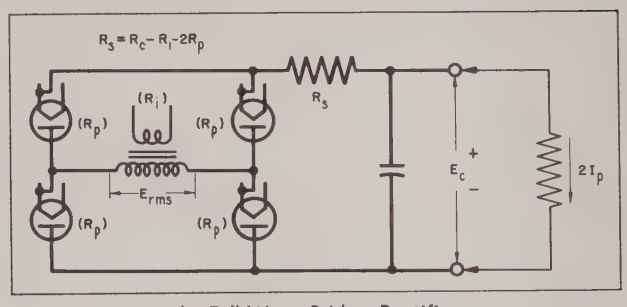


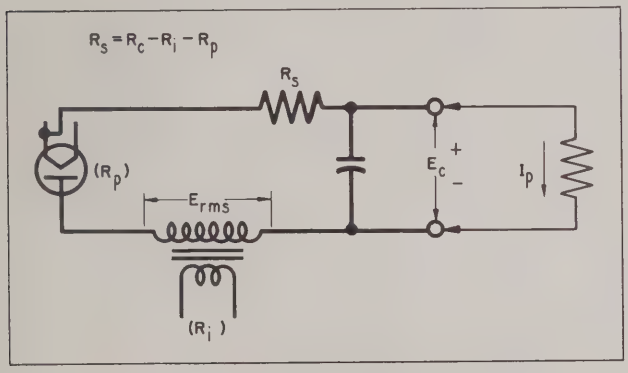
Fig. 1. Rectifier with Choke-Input Filter



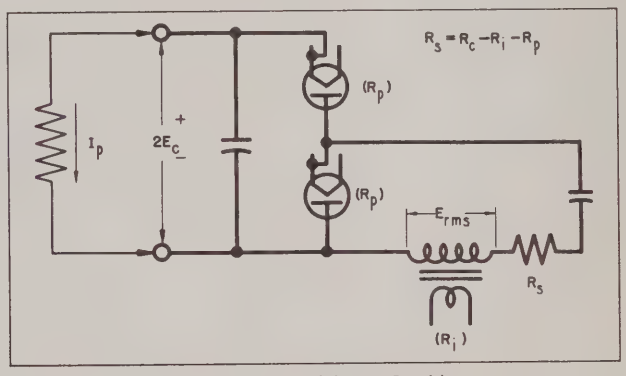
a. Full-Wave Center-Tapped Rectifier



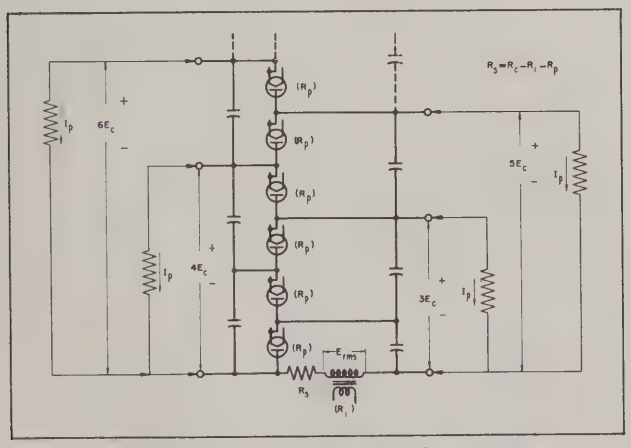
b. Full-Wave Bridge Rectifier



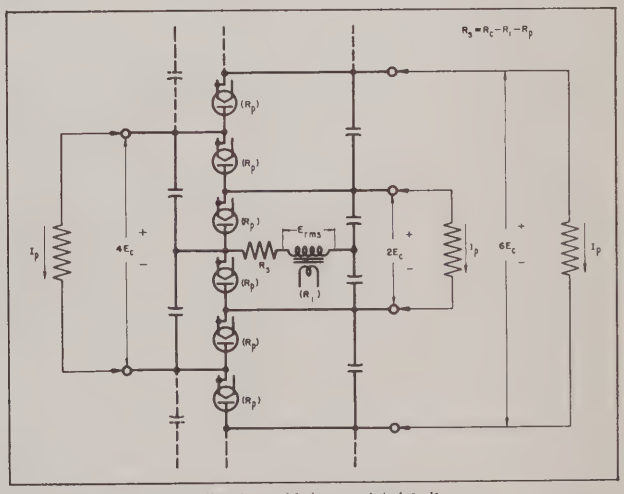
c. Half-Wave Rectifier



d. Half-Wave Voltage Doubler



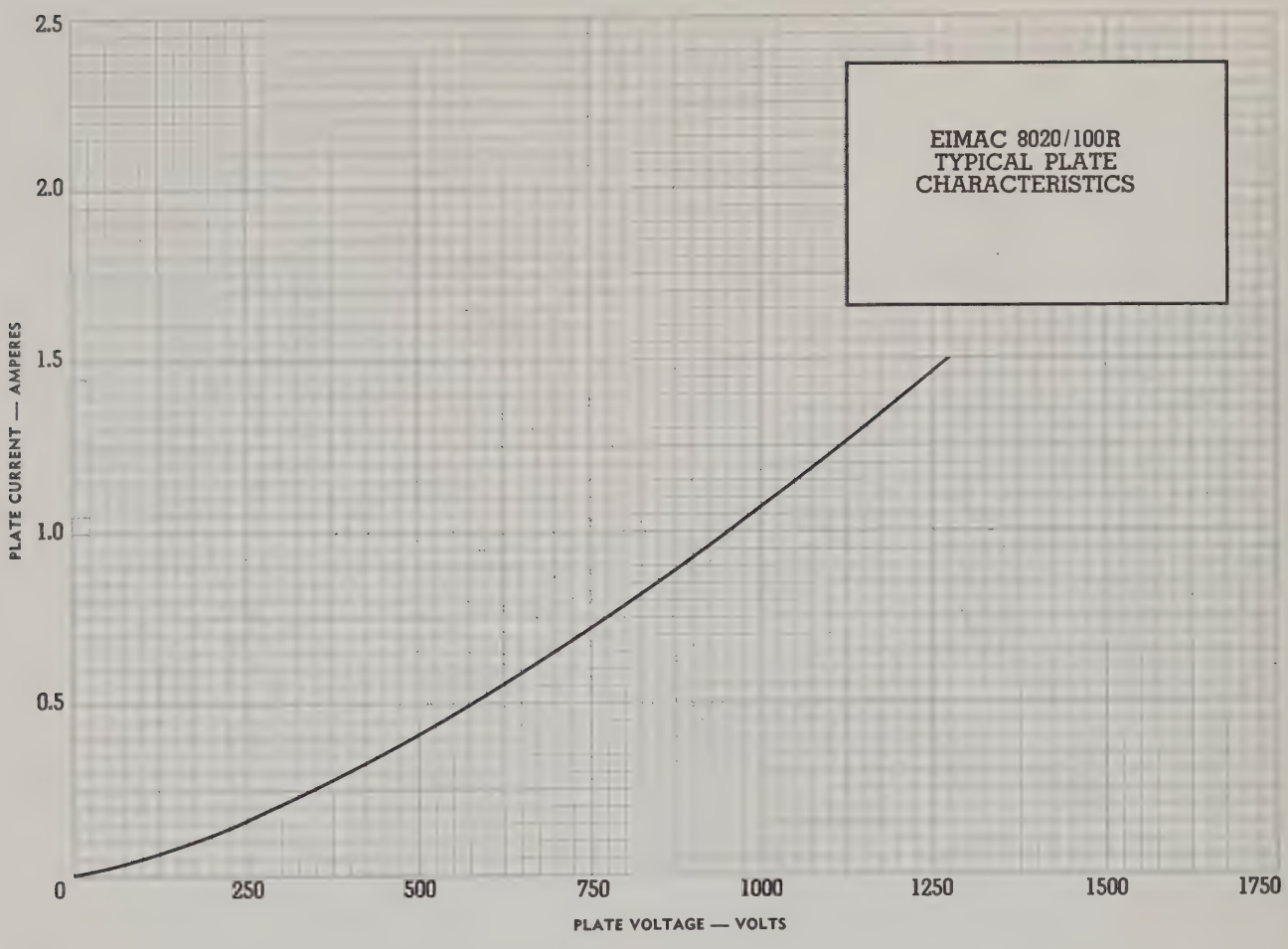
e. Half-Wave Voltage Multiplier (with common ground when R_s is inserted on the "high" side of E_{rms})

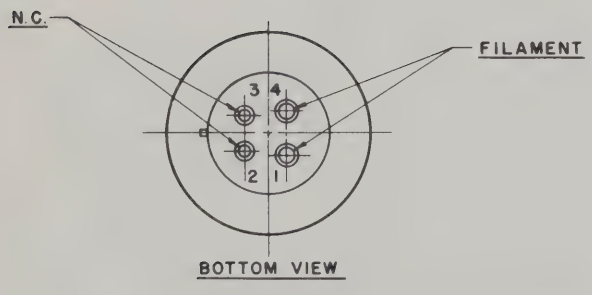


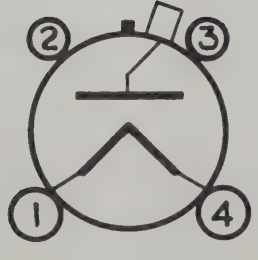
f. Full-Wave Voltage Multiplier

Eimac 8020 Maximum D-C Current Ratings for R-C Filter Applications								
D-C Plate Current (I_p)	70	75	80	85	90	95	100	milliamperes per tube
Total Charging-Circuit Resistance (R_c)	0.8	1.2	1.8	3.0	4.7	7.6	12	percent of Effective Load Resistance per Tube $\left(\frac{E_c}{I_p}\right)$
A-C Supply Voltage (E_{rms})	0.78	0.80	0.83	0.87	0.92	1.01	1.14	times Filter-Input D-C Voltage (E_c)
Peak Inverse Voltage (½ these values in circuit "b".)	2.2	2.3	2.4	2.5	2.6	2.9	3.2	times Filter-Input D-C Voltage (E_c)

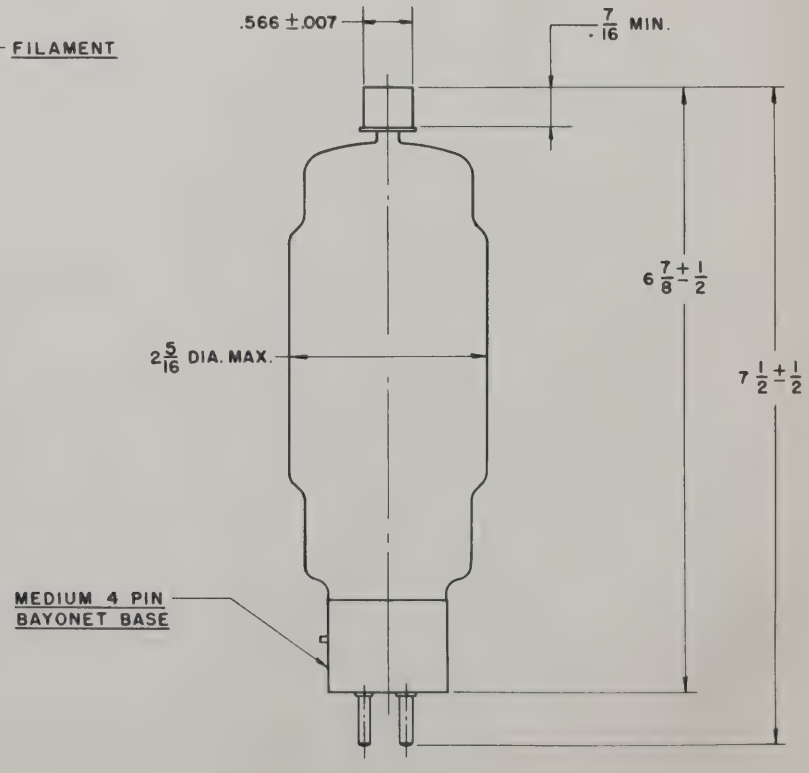
Fig. 2. Eimac 8020 Basic R-C Circuits (for any one of the indicated loads)
R_i = Equivalent resistance of voltage source
R_p = 1000 ohms (500 ohms for two tubes in parallel)







DIMENSIONS
IN INCHES



Printed in U.S.A. 69010

8252
4PR60B

RADIAL-BEAM PULSE TETRODE

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MODULATOR AMPLIFIER

EITEL-McCULLOUGH, INC.



The Eimac 8252/4PR60B is a high-vacuum tetrode intended for pulse-modulator service in circuits employing inductive or resistive loads. This tube unilaterally replaces the 715C and the 5D21 and supersedes the 4PR60A.

The 8252/4PR60B has a maximum plate dissipation rating of 60 watts, is cooled by radiation and convection, and delivers pulse output power in the region of 300 kilowatts with less than one kilowatt of pulse driving power.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-coated, Unipotential				
Heater Voltage		26.0		volts
Heater Current		2.1		amperes
Cathode Heating Time	3	5		minutes
Direct Interelectrode Capacitances				
Grid-Plate			2.0	μμf
Input	35		50	μμf
Output	6.0		11	μμf

MECHANICAL

Minimum Shock Test	190g, 0.5ms half sine
Base	Fits E. F. Johnson Co. Socket Number 122-234 or equivalent
Mounting Position	Any
Cooling	Radiation and Convection
Recommended Heat Dissipating Plate Connector	Eimac HR-8
Maximum Seal and Envelope Temperatures	200° C
Maximum Over-All Dimensions	
Length	6.000 inches
Diameter	3.063 inches
Net Weight	12 ounces
Shipping Weight	2.5 pounds

RATINGS

MAXIMUM RATINGS—Pulse Modulator Service (Per Tube)

D-C PLATE VOLTAGE	20 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	1.5 MAX. KILOVOLTS
D-C GRID VOLTAGE†	—1.0 MAX. KILOVOLT
PEAK POSITIVE GRID VOLTAGE	300 MAX. VOLTS
PEAK PLATE CURRENT	18 MAX. AMPERES
PEAK POSITIVE PLATE VOLTAGE	25 MAX. KILOVOLTS
PLATE DISSIPATION (AVERAGE)	60 MAX. WATTS
SCREEN DISSIPATION (AVERAGE)	8 MAX. WATTS
GRID DISSIPATION (AVERAGE)	1 MAX. WATT
DUTY	See chart page 4

†Effective grid-circuit resistance must not exceed 100,000 ohms.

TYPICAL OPERATION

Pulse Modulator (Per Tube)

D-C Plate Voltage	16.0	20.0	kilovolts
Pulse Plate Current	10.0	18.0	amperes
D-C Screen Voltage	1.25	1.25	kilovolts
Pulse Screen Current*	1.8	2.7	amperes
D-C Grid Voltage	—550	—600	volts
Pulse Grid Current*	0.20	0.75	ampere
Pulse Positive Grid Voltage	30	150	volts
Duty	0.0025	.001	
Pulse Duration	5	2	μsec
Peak Positive Plate Voltage	25	25	kilovolts
Pulse Input Power	160	360	kilowatts
Pulse Output Power	150	337	kilowatts
Pulse Output Voltage	15.0	18.75	kilovolts

*Approximate value.

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APPLICATION

MECHANICAL

MOUNTING—The 4PR60B may be mounted and operated in any position. A flexible connecting strap must be provided between the plate terminal and the external plate circuit.

The 4PR60B is designed to withstand 200g shocks of 0.5 millisecond duration transferred to the tube through clamps on the metal skirt. Such clamps must be shaped to fit the contour of the skirt and must be fastened to the tube before being tightened to the chassis in order that no distorting force will be applied. No lateral pressure or clamping action should be applied to the base pins or to any part of the tube other than the skirt. The skirt is internally connected to the cathode. The 4PR60B must be protected from severe vibration.

Cooling—Adequate ventilation must be provided so that seal and/or envelope temperatures do not exceed 200° C under any operating or standby condition. When the 4PR60B is operated where air circulation is restricted, these temperatures can easily reach 225° C or more which will accelerate seal deterioration and cause early tube failure.

Adequate control of the base temperature, in particular, is necessary. Envelope and plate-seal temperatures do not ordinarily require special attention provided that an HR-8 heat-dissipating plate connector is used. However, each individual application of the 4PR60B should be carefully evaluated to assure safe operating temperatures. A blower is usually required only when normal air circulation is restricted, when the ambient temperature exceeds 25° C, when the altitude is other than sea level, or when a combination of these factors exists.

ELECTRICAL

Heater Operation—The heater voltage, as measured directly at the heater pins, should be maintained at the rated value of 26.0 volts. Maximum variations in heater voltage must be kept within the range of 23.4 to 28.6 volts. Where consistent performance and long tube life are factors, the heater voltage must be kept within the range of 24.7 to 27.3 volts. The peak pulse-emission capability of the cathode may be impaired at low heater voltages, and high heater voltages contribute to short tube life.

A heater noise test is conducted periodically on 4PR60B samples. This test insures that the heater/cathode assembly will not generate excessive r-f noise during vibration over the frequency range of 10 to 50 cps.

A 500-hour heater cycling test is also conducted periodically on 4PR60B samples. This test consists of at least 1000 complete on-off cycles and insures that grid-to-cathode shorts will not occur as a result of cumulative hysteresis effects upon mechanical joints in the cathode assembly.

Cathode Operation—It is essential that the minimum cathode heating time of three minutes be observed prior to the flow of cathode current. Conservative design for reliable tube operation in pulse circuits dictates the use of five minutes minimum heating time.

The "Cathode Current Derating Chart" on page 4 depicts the current capabilities of the 4PR60B cathode at various pulse durations and duty factors. To use this chart, enter with pulse duration and note the intersection with desired pulse ***cathode*** current (the total of plate, screen, and grid currents during a particular pulse condition). At this intersection read off values of maximum duty and/or pulse repetition rate.

Under a given set of operating conditions, element dissipations may limit the maximum permissible duty to a value less than that which cathode considerations would dictate. When this occurs, it will usually be found that screen dissipation is the limiting factor under low tube-voltage-drop conditions and that plate dissipation limits the maximum duty under high tube-voltage-drop conditions.

Control-Grid Operation—The average power dissipated by the control grid of the 4PR60B must not exceed one watt. Control-grid dissipation is not usually a limiting factor with this tube, but can be computed as the product of pulse grid current, pulse positive grid voltage, and duty factor. Similarly, pulse driving power is pulse grid current times pulse grid voltage swing (bias voltage plus positive grid voltage).

Screen-Grid Operation—The average power dissipated by the screen of the 4PR60B must not exceed eight watts. Screen dissipation is the product of d-c screen voltage, pulse screen current, and duty factor. Excessive screen dissipation is likely to occur under conditions of low tube-voltage drop during conduction. This condition can be relieved by using a lower plate load resistance which will cause higher tube-voltage drop during conduction.

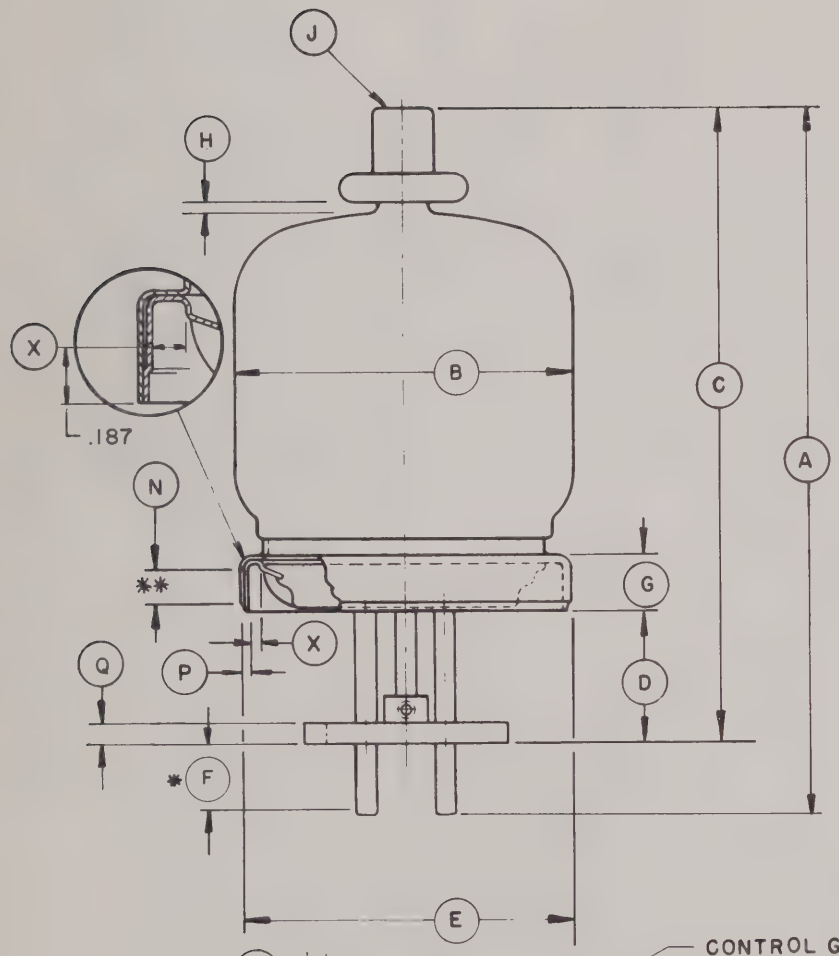
A bleeder resistance designed to draw at least 10 milliamperes of current should be connected directly from screen to cathode of the 4PR60B. This bleeder resistance will insure that only a positive current load is presented to the screen supply.

Plate Operation—The plate of the 4PR60B is radiation cooled and is rated at 60 watts maximum dissipation. Average plate dissipation must not exceed 60 watts. The 4PR60B should not be operated without a heat-dissipating plate connector such as the recommended Eimac HR-8.

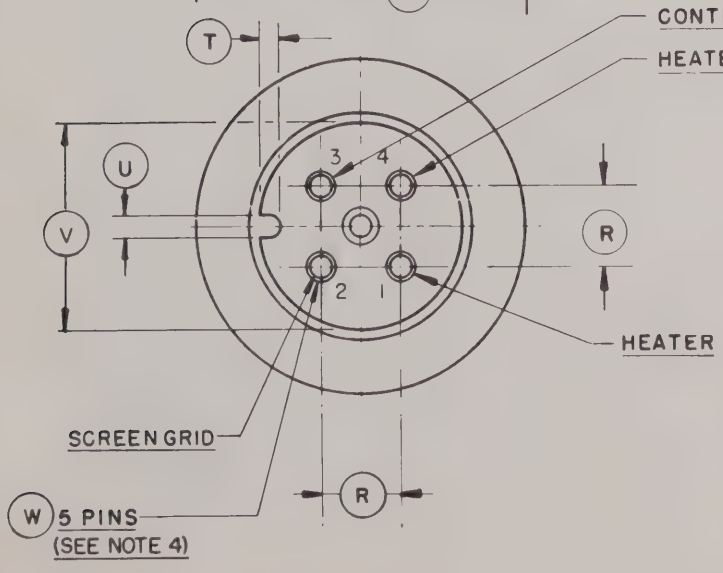
Average plate dissipation may be calculated as the product of pulse plate current, pulse tube-voltage drop, and duty factor. Excessive average plate dissipation is likely to occur at high values of pulse tube-voltage drop. The calculated value of plate dissipation may be well below 60 watts in a given case, but excessive dissipation may result if pulse rise and fall times are appreciable compared to pulse duration. This excessive plate dissipation occurs because long rise and fall times slow down the plate voltage swing and allow plate current to flow for longer periods in the high voltage-drop region.

The plate-supply voltage for the 4PR60B should not exceed 20 kilovolts. In circuits employing inductive loading, the peak instantaneous plate voltage should not exceed 25 kilovolts.

4PR60B OUTLINE DRAWING AND DIMENSIONS

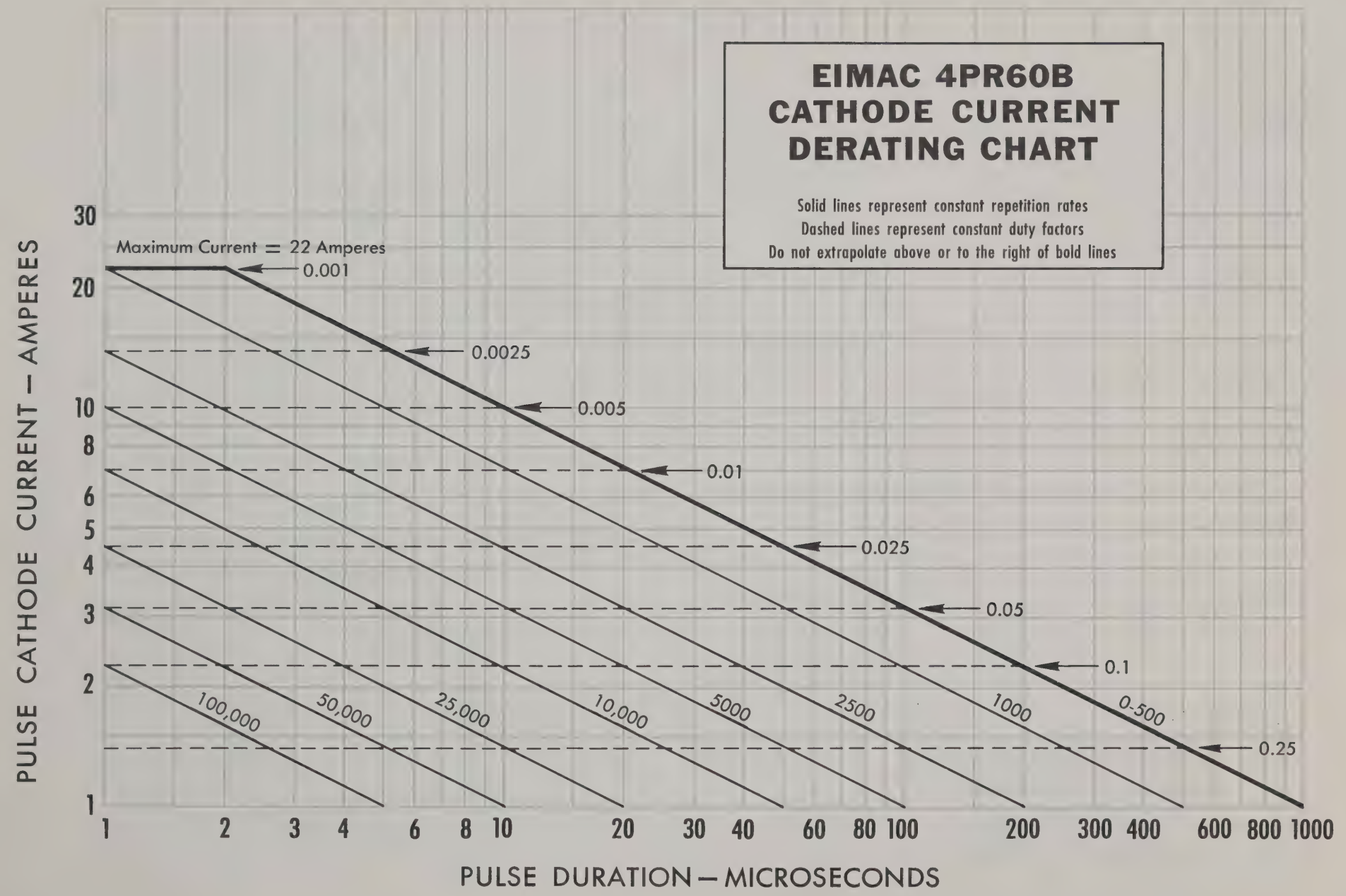


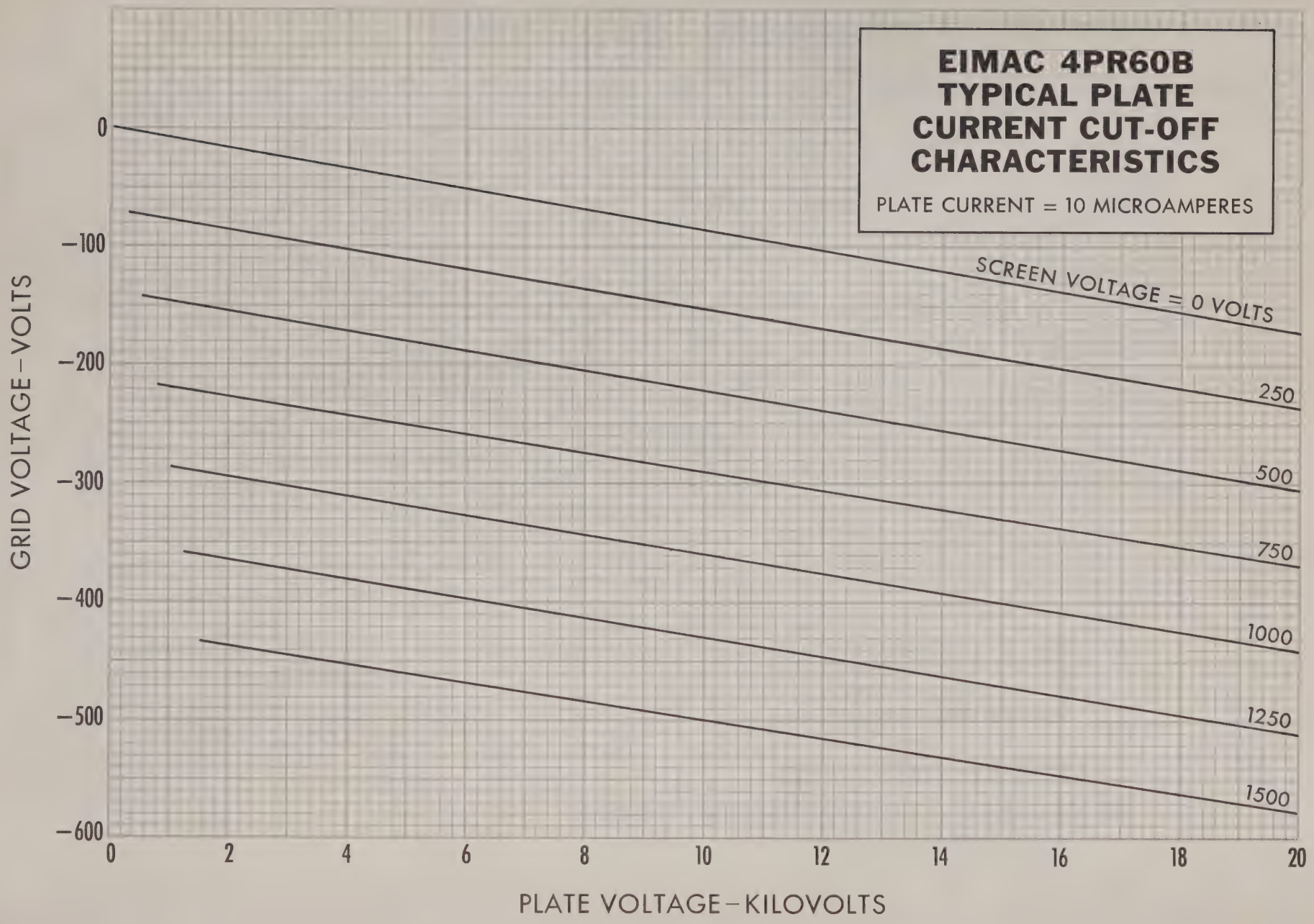
DIMENSION DATA		
REF.	MIN.	MAX.
A	5.750	6.000
B		3.063 DIA.
C	5.344	5.594
D	1.125	1.250
E	2.885 DIA.	2.905 DIA.
F	.328	
G	.438	.500
H	.016	
J	CAP: C1-41 (JEDEC DESIGNATION)	
N	.250	
P	.043	.057
Q	.188	
R	.687	
T	.171	.203
U	.171	.203
V	1.788 DIA.	1.813 DIA.
W	.183 DIA.	.191 DIA.
X	.157	

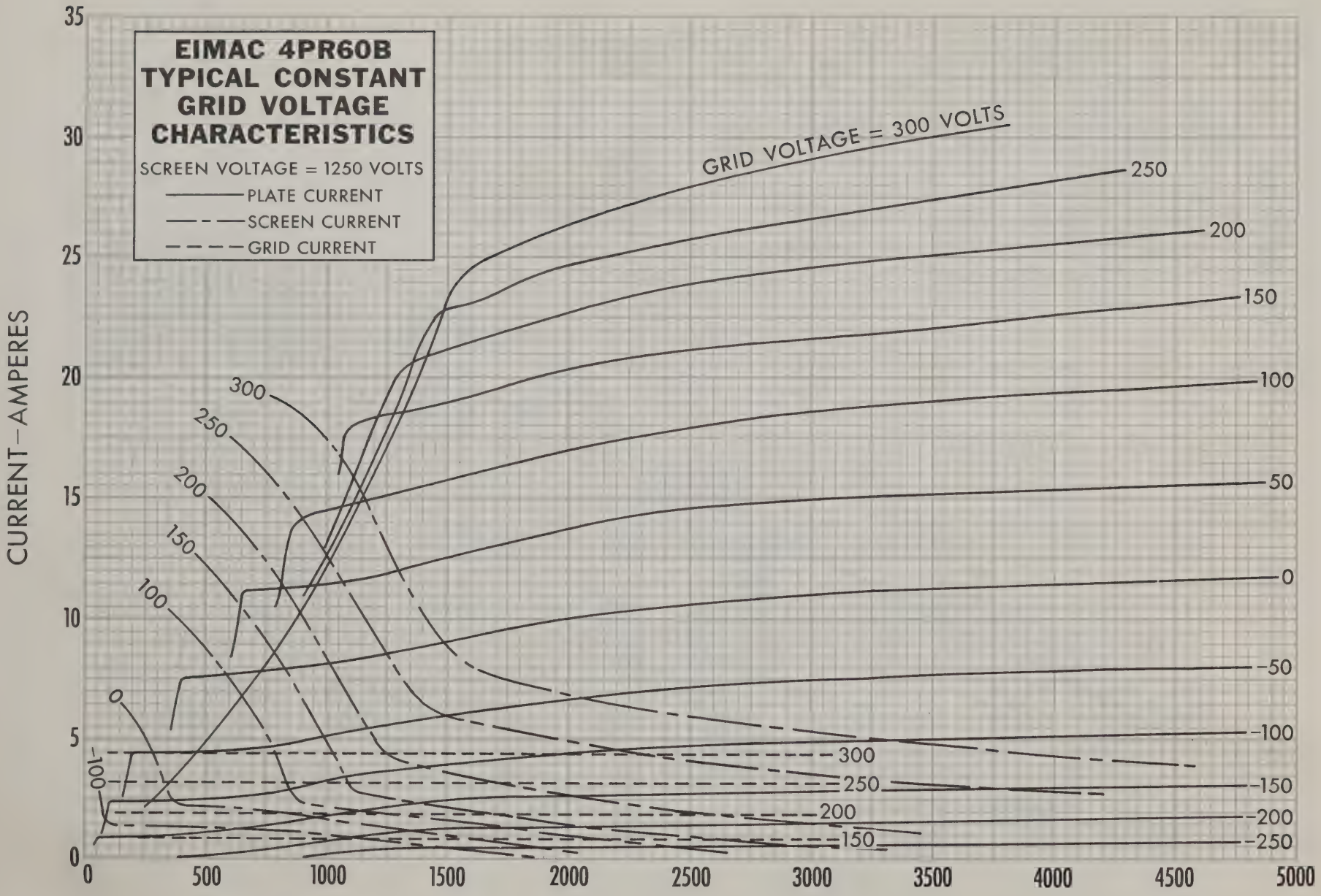


NOTES:

1. DIMENSIONS IN INCHES.
2. (*) CONTACT AREA.
3. (**) DEFINES CYLINDRICAL AREA AVAILABLE FOR CLAMPING WHICH MUST NOT BE DISTORTED BY CLAMPING ACTION.
4. THE BASE PINS SHALL BE CAPABLE OF ENTERING A GAUGE 1/4 INCH THICK HAVING FOUR .214" DIA. HOLES LOCATED ON 11/16 CENTERS AND A CENTER HOLE .250 DIA


EIMAC 4PR60B
CATHODE CURRENT
DERATING CHART
Solid lines represent constant repetition rates
Dashed lines represent constant duty factors
Do not extrapolate above or to the right of bold lines
Maximum Current = 22 Amperes
0.001
0.0025
0.005
0.01
0.025
0.05
0.1
0.25
0-500
1000
2500
5000
10,000
25,000
50,000
100,000
PULSE CATHODE CURRENT — AMPERES
30
20
10
8
6
5
4
3
2
1
1
2
3
4
6
8
10
20
30
40
60
80
100
200
300
400
600
800
1000
PULSE DURATION — MICROSECONDS


EIMAC 4PR60B
TYPICAL PLATE
CURRENT CUT-OFF
CHARACTERISTICS
PLATE CURRENT = 10 MICROAMPERES
SCREEN VOLTAGE = 0 VOLTS
250
500
750
1000
1250
1500
0
−100
−200
−300
−400
−500
−600
GRID VOLTAGE – VOLTS
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE – KILOVOLTS


EIMAC 4PR60B
TYPICAL CONSTANT
GRID VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE = 1250 VOLTS
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
GRID VOLTAGE = 300 VOLTS
250
200
150
100
50
0
-50
-100
-150
-200
-250
300
250
200
150
100
0
-100
CURRENT–AMPERES
PLATE VOLTAGE–VOLTS
0
5
10
15
20
25
30
35
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000

EITEL-McCULLOUGH, INC.

8187
4PR65A

RADIAL-BEAM PULSE TETRODE

●

MODULATOR OSCILLATOR AMPLIFIER

The Eimac 8187/4PR65A is a pulse tetrode intended for use in pulse-modulator, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a Pyrovac plate and non-emitting grids, is recommended for use in new equipments where high voltage, high current, or high duty factor is encountered.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage	-	6.0		volts
Current	3.2		3.8	amperes
Amplification Factor (Grid to Screen)	-	6.0		
Direct Interelectrode Capacitances, Grounded Cathode:†				
Grid-Plate	-	-	0.12	uuf
Input	6.0		8.3	uuf
Output	1.9		2.6	uuf
Highest Frequency for Maximum Ratings	-	-	150	mc

MECHANICAL

Base	5-pin
Basing	See drawing
Recommend Socket	National HX-29 or Johnson 122-101
Operating Position	Vertical, base down or up
Maximum Operating Temperatures:	
Base Seals	200°C
Plate Seal	225°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	4.19 inches
Diameter	2.38 inches
Net Weight (tube only)	3 ounces
Shipping Weight	1.5 pounds

†In Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

DC PLATE VOLTAGE	15 MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
DC GRID VOLTAGE	—1.0 MAX. KILOVOLT
PEAK PLATE CURRENT	1.0 MAX. AMPERES
PLATE DISSIPATION (AVG.)	65 MAX. WATTS
SCREEN DISSIPATION (AVG.)	10 MAX. WATTS
GRID DISSIPATION (AVG.)	5 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	5	10	15 kilovolts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage	—180	—225	—270 volts
Pulse Plate Voltage	4.35	9.35	14.35 kilovolts
Peak Plate Current	0.95	0.95	0.95 amperes
Pulse Screen Current	0.20	0.20	0.20 ampere
Pulse Grid Current	0.12	0.12	0.12 ampere
Pulse Pos. Grid Voltage	100	100	100 volts
Pulse Drive Power	33.6	39.0	44.5 watts
Pulse Plate Input Power	4.75	9.50	14.25 kilowatts
Pulse Plate Output Power	4.10	8.85	13.60 kilowatts
Duty	10	10	10 percent

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RADIO-FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR*

MAXIMUM RATINGS

PEAK DC PLATE VOLTAGE	10 MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KOLOVOLT
PEAK CATHODE CURRENT (Note 1)	1.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	65 MAX. WATTS
SCREEN DISSIPATION (AVG.)	10 MAX. WATTS
GRID DISSIPATION (AVG.)	5 MAX. WATTS

*When used as a RF Plate-and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid overheating this element during the inter-pulse periods.

TYPICAL OPERATION

Pulse Plate Voltage	5	7.5	10 kilovolts
Pulse Screen Voltage	500	500	500 volts
DC Grid Voltage	—265	—300	—335 volts
Pulse Plate Current (Note 1)	200	200	200 mA
Pulse Screen Current	20	20	20 mA
Pulse Grid Current	12	12	12 mA
Peak RF Grid Voltage	370	405	440 volts
Pulse Drive Power	4.5	4.85	5.3 watts
Pulse Plate Input Power	1000	1500	2000 watts
Pulse Plate Output Power	815	1270	1720 watts
Duty	35	28	23 percent

RADIO-FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS

DC PLATE VOLTAGE	7.5 MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
DC GRID VOLTAGE	—1.0 MAX. KILOVOLT
PEAK CATHODE CURRENT (Note 1)	1.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	65 MAX. WATTS
SCREEN DISSIPATION (AVG.)	10 MAX. WATTS
GRID DISSIPATION (AVG.)	25 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	4.5	6.0	7.5 kilovolts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage	—260	—280	—300 volts
Pulse Plate Current (Note 1)	200	200	200 mA
Pulse Screen Current	20	20	20 mA
Pulse Grid Current	12	12	12 mA
Peak RF Grid Voltage	365	385	405 volts
Pulse Drive Power	4.4	4.6	4.9 watts
Pulse Plate Input Power	900	1200	1500 watts
Pulse Plate Output Power	725	1000	1265 watts
Duty	37	32	27 percent

Note 1: The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the dc plate current component during the pulse.

APPLICATION

MECHANICAL

Mounting—The 8187/4PR65A must be operated vertically, base up or down. The socket must provide clearance for the glass tip-off which extends from the center of the base. A flexible connecting strap should be provided between the plate terminal and the external plate circuit, and the Eimac HR-6 connector (or equivalent) used on the tube plate lead. The socket must not apply lateral pressure against the base pins. The tube must be protected from severe vibration and shock.

Cooling—When the inlet air temperature does not exceed 30° C it will not ordinarily be necessary to provide forced-air cooling of the envelope or the plate seal at frequencies below 30 Mc. provided the HR-6 Heat-Radiating plate connector is used and the tube is so located that normal circulation of air past the envelope is not impeded.

In the event the inlet air temperature is expected to be greater than 30° C, adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 200° C and 225° C, respectively. In all classes of operation it is recommended that a heat radiating connector, the Eimac HR-6 or equivalent, be installed on the anode terminal, and that a socket be employed which provides for proper seal cooling. When the Eimac 8187/4PR65A, utilizing an HR-6 heat radiator, is operated at dc or low frequencies in a Johnson 122-101 socket, the minimum airflow requirements to maintain seal temperatures at 200° C in 50° C inlet air are tabulated below:

	Sea Level		10,000 Feet	
Avg. Plate Dissipation (watts)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)
40	1.7	0.013	2.5	0.02
50	2.4	0.024	3.5	0.04
65	3.3	0.036	4.8	0.06

When the Eimac 8187/4PR65A is used as a pulsed-amplifier or oscillator at frequencies above 30 Mc, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by rf charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature-sensitive paint.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be 6.0 volts. Variations in filament voltage must

be kept within the range of 5.7 to 6.3 volts.

When the 8187/4PR65A is utilized in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

Element Dissipation—Under normal operating conditions, the average plate dissipation of the 8187/4PR65A should not be allowed to exceed 65 watts. Dissipation in excess of this maximum rating is permissable for short periods of time, such as during tuning procedures.

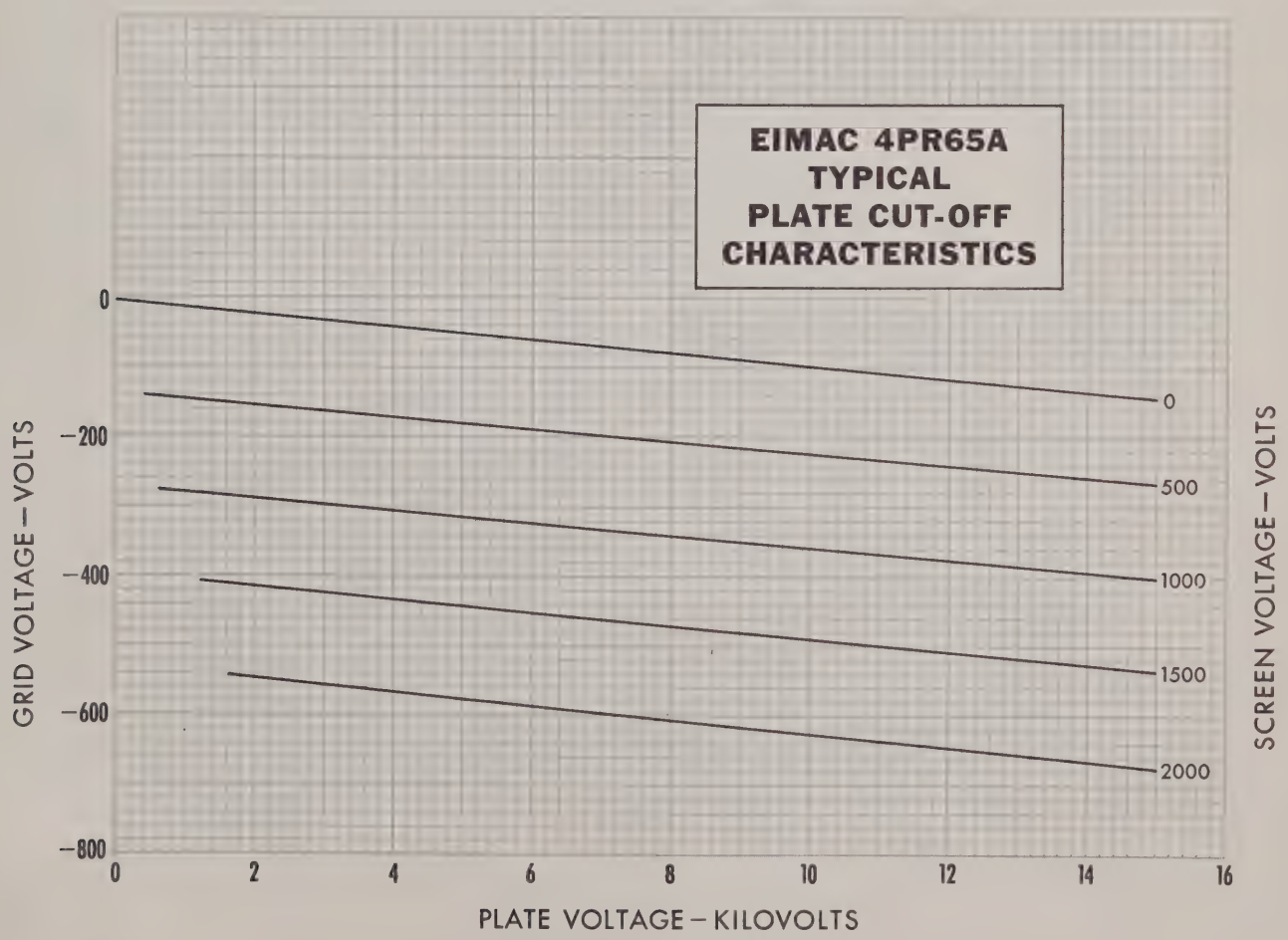
The average power dissipated by the screen-grid and the control-grid must not exceed 10 watts and 5 watts, respectively.

Cut-Off Characteristics—The Plate Current Cut-Off Characteristics of the 8187/4PR65A are shown in the graph below. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristics closely approximate the mean value in the tube test specification.

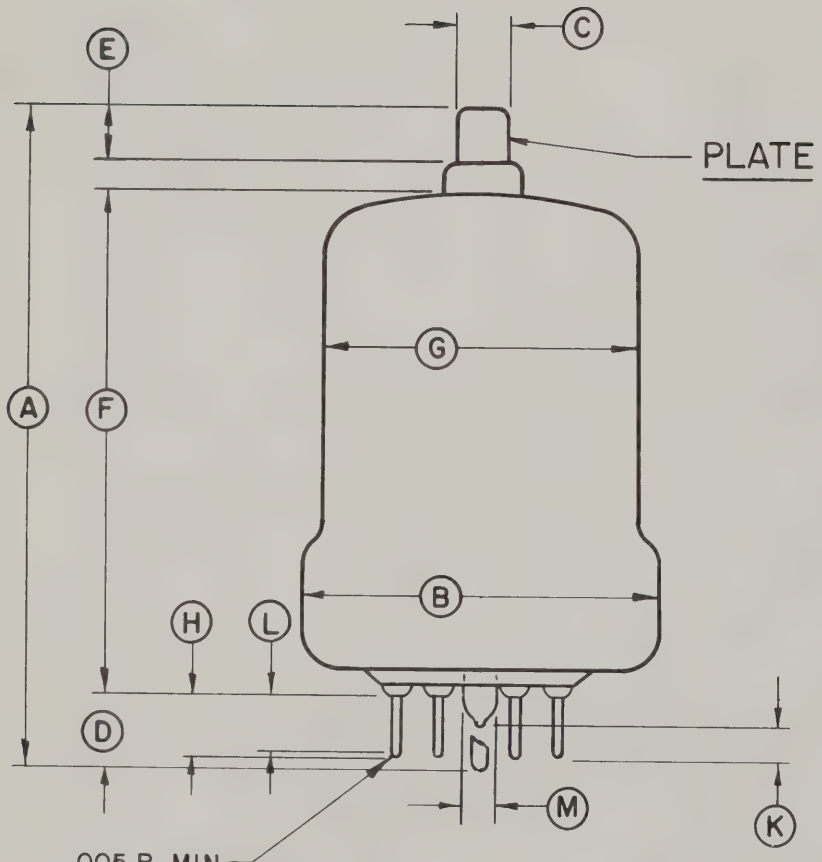
Each 8187/4PR65A is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 15 KV, a screen voltage of 1.5 KV with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 575 volts. Due to tube-to-tube variations this cut-off point will vary and the typical range can be expected to be between 350 volts and 500 volts.

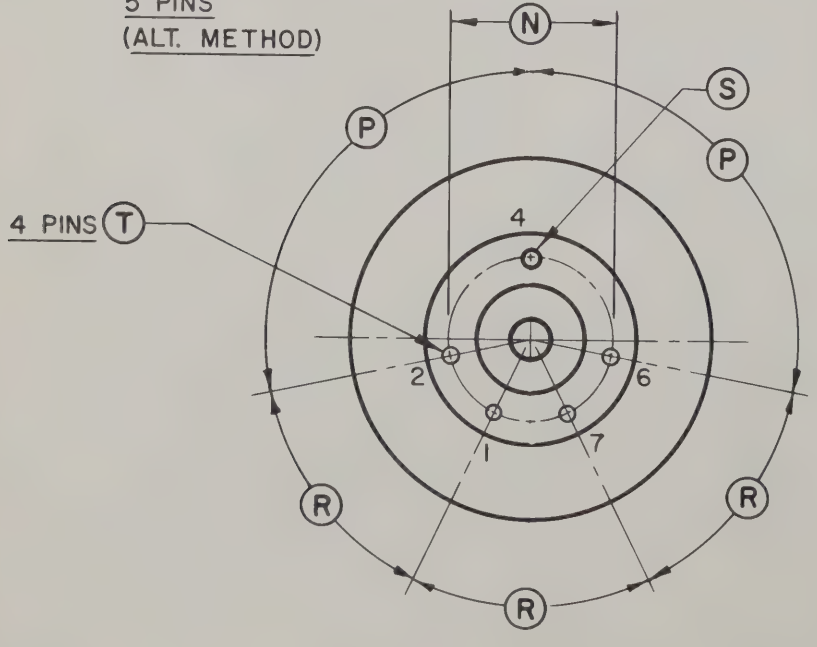
Pulse-Modulator Service—The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate waveform is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

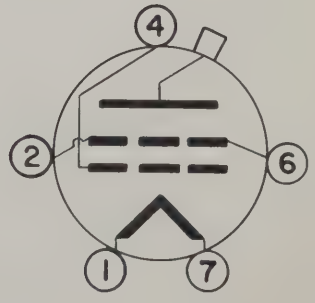
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, please write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

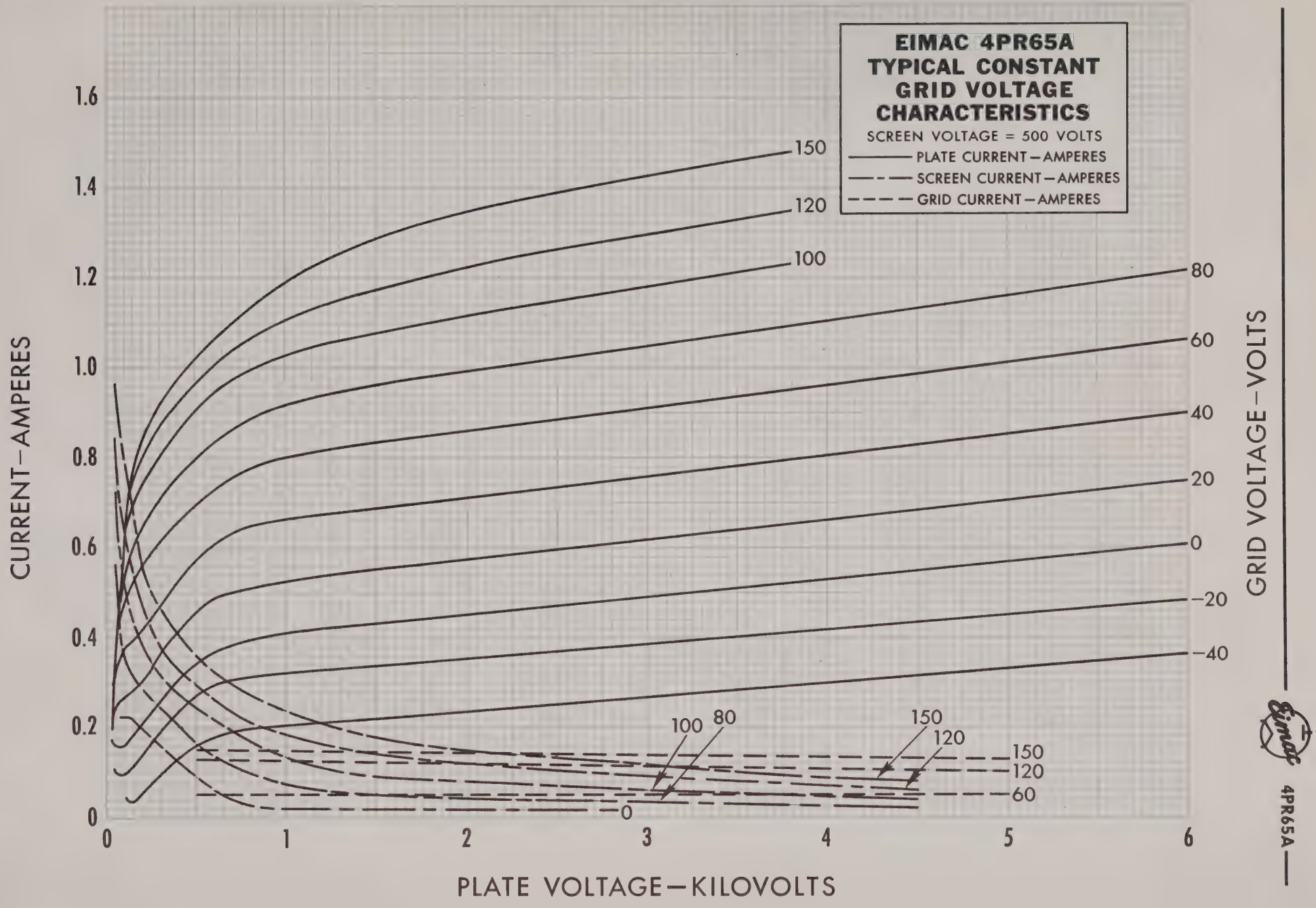


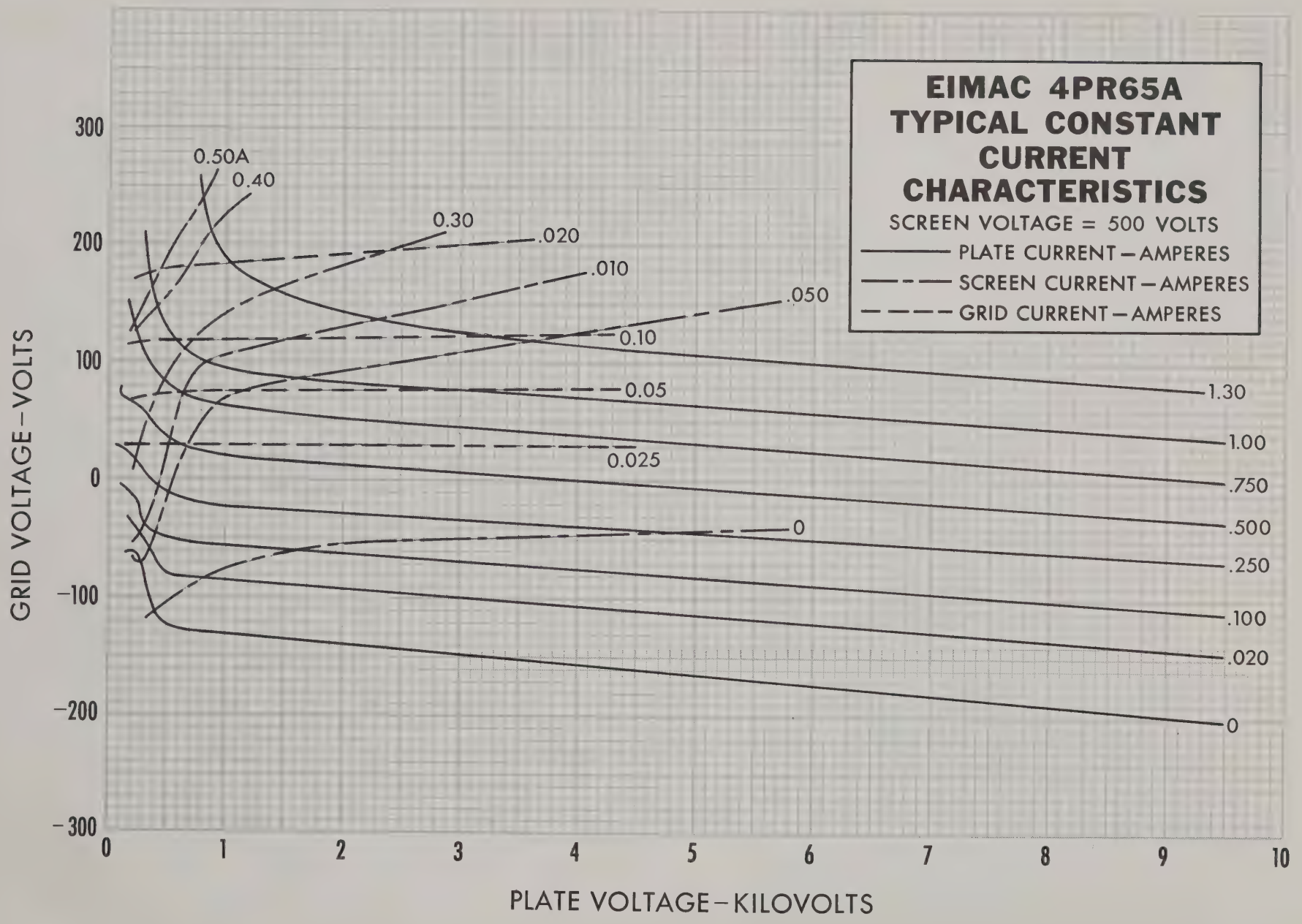
DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4	4-3/16	
B		2-3/8	
C	.350	.365	
D	7/16	9/16	
E	21/64		
F	2-15/16	3-5/16	
G		2-1/8	
H	3/8	1/2	
K	.000		
L	5/16		
M		3/8	
N			1.000
P			102°
R			52°
S	.122 DIA.	.128 DIA.	
T	.055 DIA.	.061 DIA.	








EIMAC 4PR65A
TYPICAL CONSTANT
GRID VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
CURRENT – AMPERES
PLATE VOLTAGE – KILOVOLTS
GRID VOLTAGE – VOLTS
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
150
120
100
80
60
40
20
0
–20
–40
100
80
150
120
150
120
60
0
Eimac
4PR65A


EIMAC 4PR65A
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
300
200
100
0
−100
−200
−300
0
1
2
3
4
5
6
7
8
9
10
0.50A
0.40
0.30
.020
.010
.050
0.10
0.05
0.025
0
1.30
1.00
.750
.500
.250
.100
.020
0

Eimac®

EITEL-McCULLOUGH, INC.

8247
4PR125A

RADIAL-BEAM PULSE TETRODE MODULATOR OSCILLATOR AMPLIFIER



The Eimac 8247/4PR125A is a pulse tetrode intended for use in pulse-modulator, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a Pyrovac plate and non-emitting grids, is recommended for use in new equipments where high voltage, high current, or high duty factor is encountered.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the Eimac SK-410 Air-System Socket and the SK-406 Air Chimney.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage	-	5.0		volts
Current	6.0		7.0	amperes
Amplification Factor (Grid to Screen)	-	5.9		
Direct Interelectrode Capacitances, Grounded Cathode: †				
Grid-Plate	-	-	0.07	uuf
Input	9.2	-	12.4	uuf
Output	2.5	-	3.5	uuf
Transconductance (1_b = 50 ma)	-	2,450		umhos
Highest Frequency for Maximum Ratings	-	-	120	mc

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommend Socket	Eimac SK-410 Air-System Socket
Operating Position	Vertical, base down or up
Maximum Operating Temperatures:	
Base Seals	200°C
Plate Seal	170°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	5.69 inches
Diameter	2.81 inches
Net Weight (tube only)	6.5 ounces
Shipping Weight	1.5 pounds

† in Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	18 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
D-C GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK PLATE CURRENT	1.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	125 MAX. WATTS
SCREEN DISSIPATION (AVG.)	20 MAX. WATTS
GRID DISSIPATION (AVG.)	5 MAX. WATTS

TYPICAL OPERATION				
D-C Plate Voltage	10	14	18	kilovolts
D-C Screen Voltage	1.0	1.0	1.0	kilovolts
D-C Grid Voltage	-245	-260	-275	volts
Pulse Plate Voltage	9.0	13.0	17.0	kilovolts
Peak Plate Current	1.0	1.0	1.0	ampere
Pulse Screen Current	0.2	0.2	0.2	ampere
Pulse Grid Current	25	25	25	ma
Pulse Pos. Grid Voltage	30	30	30	volts
Pulse Drive Power	6.9	7.3	7.7	watts
Pulse Plate Input Power	10	14	18	kilowatts
Pulse Plate Output Power	9	13	17	kilowatts
Duty	10	10	10	percent

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RADIO-FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR*

MAXIMUM RATINGS	
PEAK D-C PLATE VOLTAGE	12 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
D-C GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK CATHODE CURRENT**	2.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	125 MAX. WATTS
SCREEN DISSIPATION (AVG.)	20 MAX. WATTS
GRID DISSIPATION (AVG.)	5 MAX. WATTS

*When used as a R-F Plate-and Screen-Pulsed Amplifier the grid drive must also be pulsed to avoid overheating this element during the inter-pulse periods.

TYPICAL OPERATION				
Pulse Plate Voltage	8	10	12	kilovolts
Pulse Screen Voltage	1.0	1.0	1.0	kilovolt
D-C Grid Voltage	-380	-390	-400	volts
Pulse Plate Current **	416	416	416	ma
Pulse Screen Current	36	36	36	ma
Pulse Grid Current	6	6	6	ma
Peak R-F Grid Voltage	520	530	540	volts
Pulse Drive Power	3.12	3.18	3.25	watts
Pulse Plate Input Power	3.33	4.16	5.0	kilowatts
Pulse Plate Output Power	2.52	3.24	4.0	kilowatts
Duty	15	13	12	percent

RADIO-FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	9.0 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
D-C GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK CATHODE CURRENT**	2.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	125 MAX. WATTS
SCREEN DISSIPATION (AVG.)	20 MAX. WATTS
GRID DISSIPATION (AVG.)	5 MAX. WATTS

TYPICAL OPERATION				
D-C Plate Voltage	5	7	9	kilovolts
D-C Screen Voltage	1.5	1.5	1.5	kilovolts
D-C Grid Voltage	-365	-375	-385	volts
Pulse Plate Current **	416	416	416	ma
Pulse Screen Current	36	36	36	ma
Pulse Grid Current	6	6	6	ma
Peak R-F Grid Voltage	505	515	525	volts
Pulse Drive Power	3.0	3.1	3.2	watts
Pulse Plate Input Power	2.08	2.92	3.75	kilowatts
Pulse Plate Output Power	1.44	2.16	2.88	kilowatts
Duty	19	16	14	percent

**

The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the d-c plate current component during the pulse.

APPLICATION

MECHANICAL

Mounting— The 4PR125A must be operated vertically, base up or down. When the SK-410 Air-System Socket is used in conjunction with the SK-406 Air Chimney, the socket must be mounted to the under surface of the chassis to maintain proper air space between the plate seal and the chimney opening, otherwise plate seal cooling will be seriously impaired.

In the event the SK-410 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers.

Cooling— Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 200° C and 170° C, respectively. In all classes of operation it is recommended that a heat-radiating connector, the Eimac HR-6 or equivalent, be installed on the anode terminal, and that a socket and chimney be employed which provides for proper seal cooling. When the Eimac 4PR125A is operated at d-c or low frequencies in an Eimac SK-410 Air-System Socket, complete with SK-406 Air Chimney and HR-6 Heat Radiator, the minimum airflow requirements to maintain seal temperatures at 170° C in 50° C inlet air are tabulated:

	Sea Level		10,000 Feet	
Ave. Plate Dissipation (watts)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)
50	5.0	0.014	7.2	0.020
100	8.0	0.016	10.2	0.023
125	10.0	0.018	14.2	0.026

When the Eimac 4PR125A is used as a pulsed-amplifier or oscillator at frequencies above 30 Mc, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by r-f charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature-sensitive paint.

ELECTRICAL

Filament Voltage— For maximum tube life the filament voltage, as measured directly at the filament pins, should be 5.0 volts. Variations in filament voltage must be kept within the range of 4.75 to 5.25 volts.

When the 4PR125A is utilized in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

Element Dissipation—Under normal operating conditions, the average plate dissipation of the 4PR125A should not be allowed to exceed 125 watts. Dissipation in excess of this maximum rating is permissable for short periods of time, such as during tuning procedures.

The average power dissipated by the screen-grid and the control-grid must not exceed 20 watts and 5 watts, respectively.

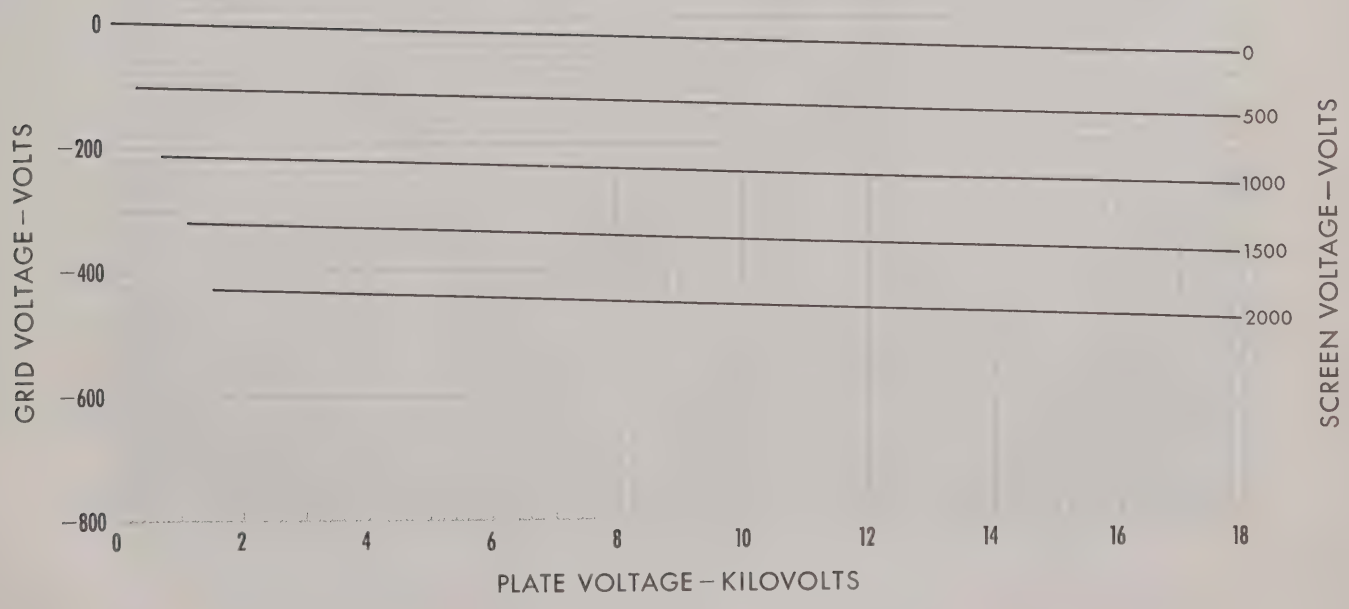
Cut-Off Characteristics— The Plate Current Cut-Off Characteristics of the 4PR125A are shown in the graph below. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristics closely approximate the mean value in the tube test specification.

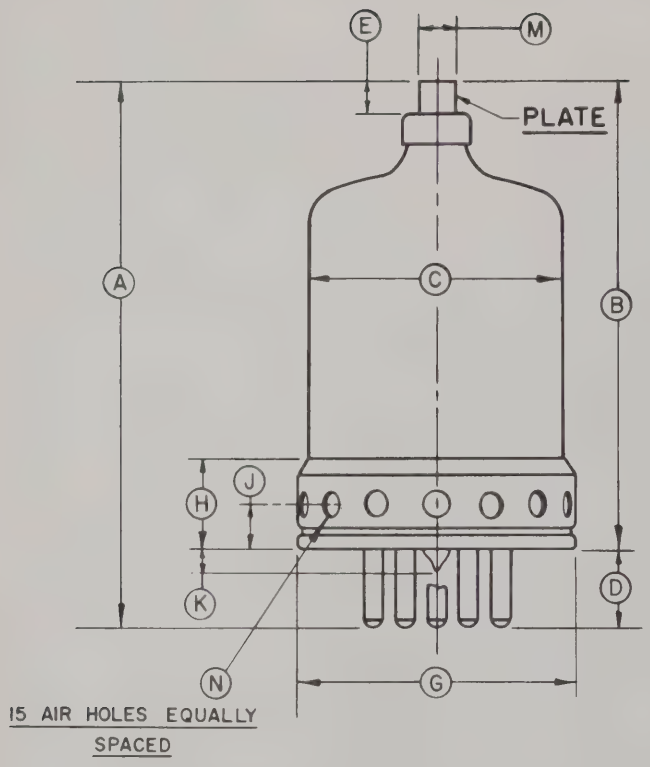
Each 4PR125A is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 18 KV, a screen voltage of 1.5 KV with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 450 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between -370 volts and -445 volts.

Pulse-Modulator Service— The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage waveform, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate waveform is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

Special Applications— If it is desired to operate this tube under conditions widely different from those given here write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

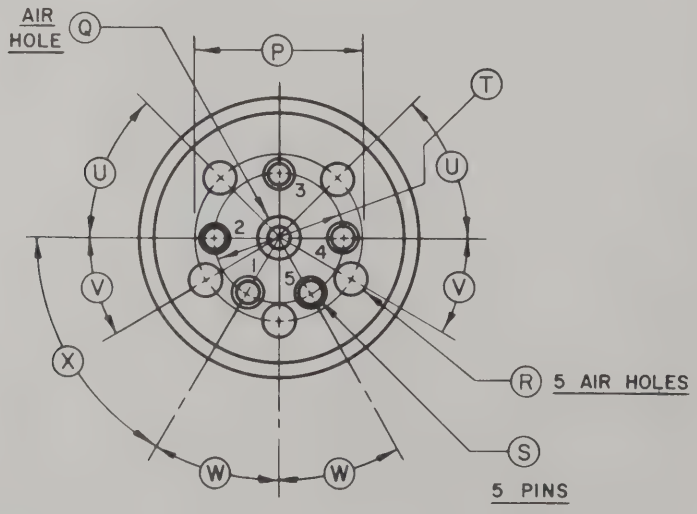
EIMAC 4PR125A TYPICAL PLATE CUT-OFF CHARACTERISTICS



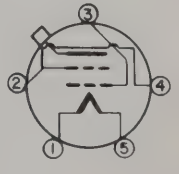


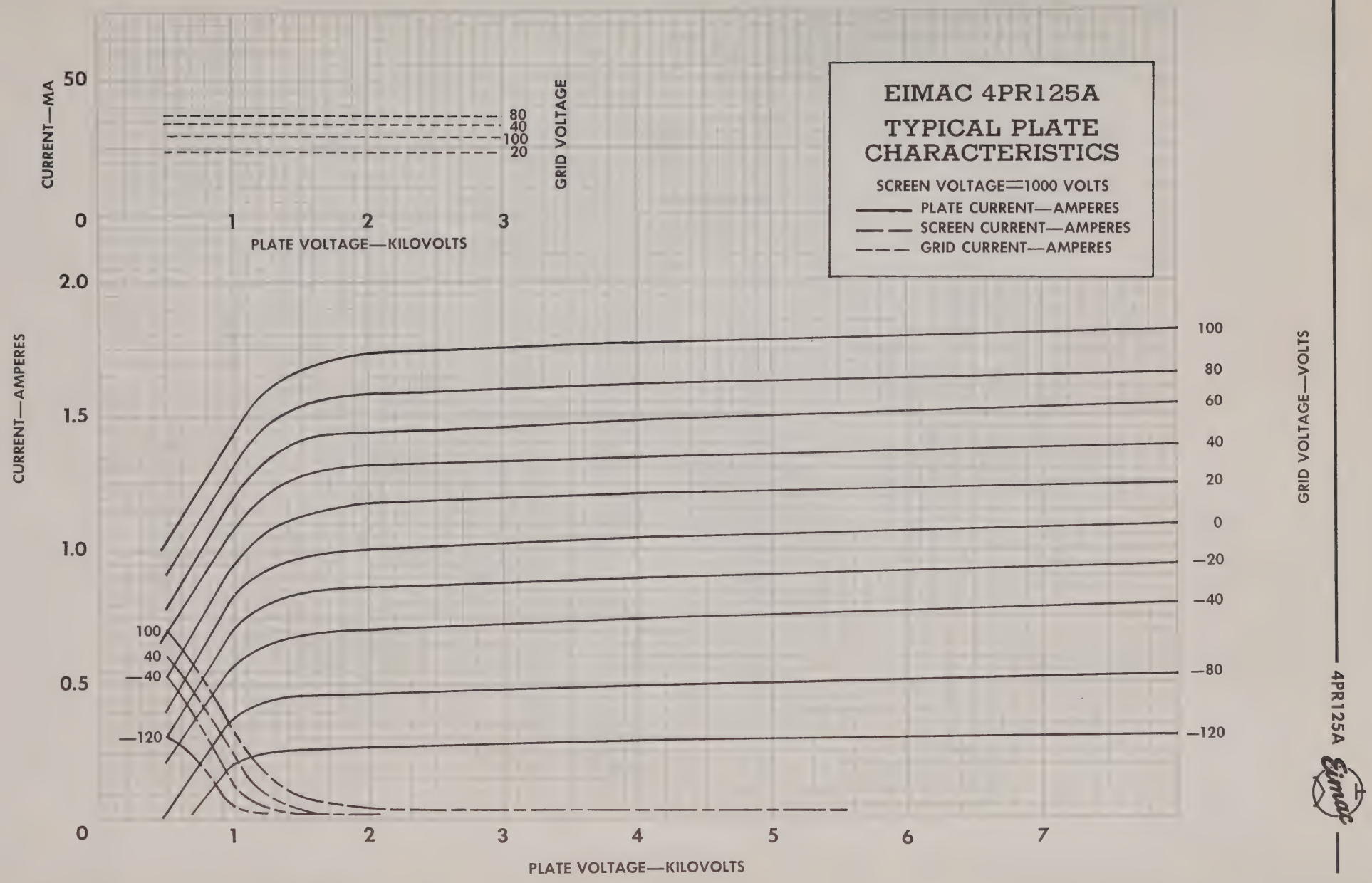
DIMENSIONS IN INCHES

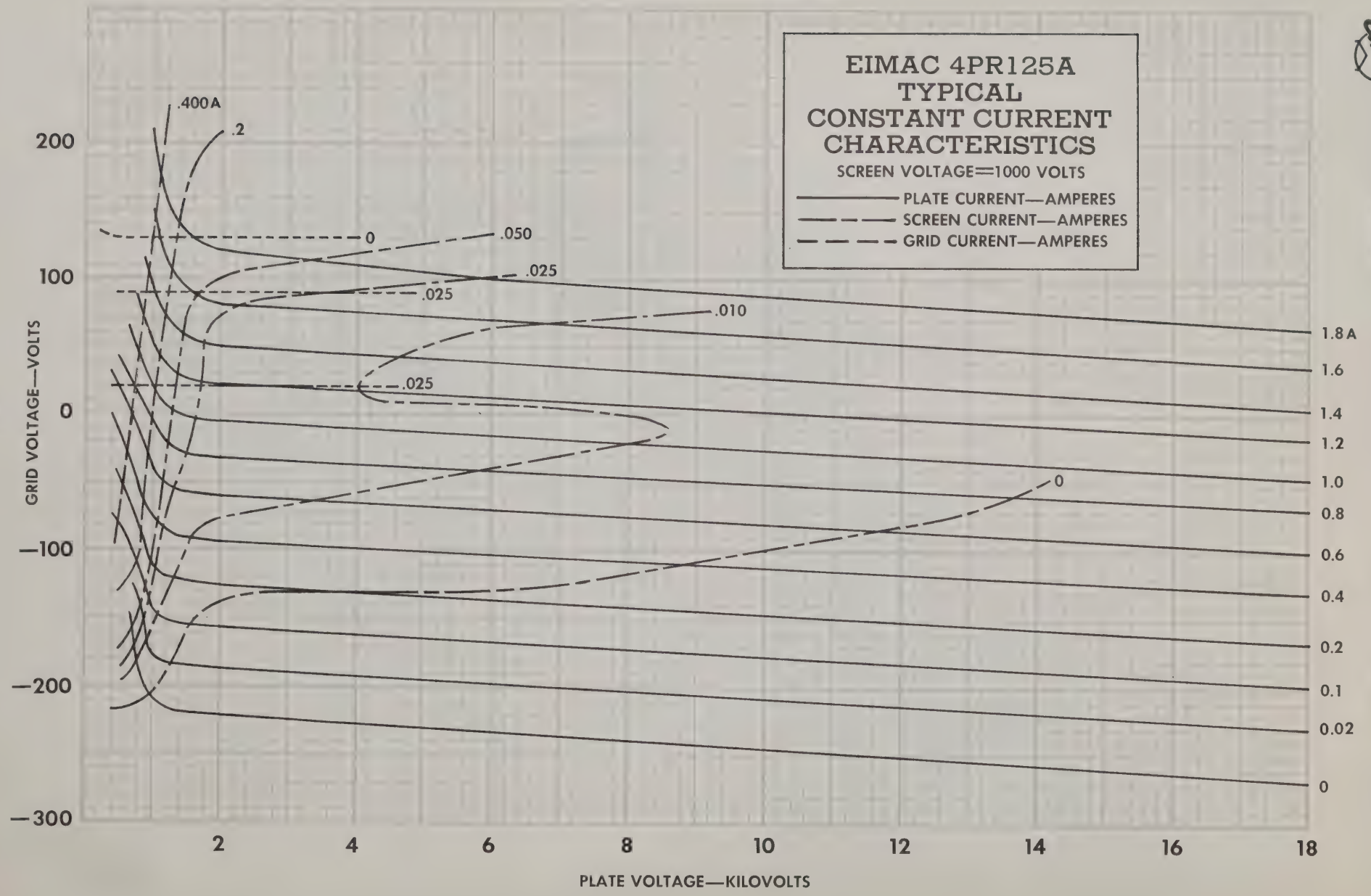
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	5-3/16	5-11/16	5-7/16
B	4-7/16	4-15/16	4-11/16
C		2-5/8 D.	
D			3/4
E	21/64		
F		2-13/16D.	
G		2-3/4 D.	
H		31/32	
J			7/16
K		1/4	
L			7/16
M	.350 D.	.365 D.	.360 D.
N			1/4 D.
P			1 5/8 D.
Q			1/2 D.
R			5/16 D.
S	.185 D.	.191 D.	.188 D.
T			1 1/4 D.
U			45°
V			30°
W			30°
X			60°



BOTTOM VIEW




EIMAC 4PR125A
TYPICAL PLATE CHARACTERISTICS
SCREEN VOLTAGE=1000 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
CURRENT—MA
50
0
1
2
3
PLATE VOLTAGE—KILOVOLTS
GRID VOLTAGE
80
40
100
20
CURRENT—AMPERES
2.0
1.5
1.0
0.5
0
100
40
—40
—120
1
2
3
4
5
6
7
PLATE VOLTAGE—KILOVOLTS
100
80
60
40
20
0
—20
—40
—80
—120
GRID VOLTAGE—VOLTS
4PR125A
Eimac


EIMAC 4PR125A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE=1000 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
.400A
.2
0
.050
.025
.025
.010
.025
0
1.8A
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.1
0.02
0
200
100
0
—100
—200
—300
GRID VOLTAGE—VOLTS
2
4
6
8
10
12
14
16
18
PLATE VOLTAGE—KILOVOLTS

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

8188
4PR400A

RADIAL-BEAM PULSE TETRODE MODULATOR OSCILLATOR AMPLIFIER

The Eimac 8188/4PR400A is a pulse tetrode intended for use in pulse-modulator, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a Pyrovac plate and non-emitting grids, is recommended for use in new equipments where high voltage, high current, or high duty factor is encountered.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the Eimac SK-410 Air-System Socket and the SK-406 Air Chimney.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage	-	5.0		volts
Current	13.5		14.7	amperes
Amplification Factor (Grid to Screen)	-	5.1		
Direct Interelectrode Capacitances, Grounded Cathode:*				
Grid-Plate	-	-	0.17	uuf
Input	10.7		14.5	uuf
Output	4.2		5.6	uuf
Transconductance (1_b = 100 ma)	-	4,000		umhos
Highest Frequency for Maximum Ratings	-	-	110	mc

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommend Socket	Eimac SK-410 Air-System Socket
Operating Position	Vertical, base down or up
Maximum Operating Temperatures:	
Base Seals	200° C
Plate Seal	225° C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Net Weight (tube only)	9 ounces
Shipping Weight	2.5 pounds

*In Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	20 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION (AVG.)	400 MAX. WATTS
SCREEN DISSIPATION (AVG.)	35 MAX. WATTS
GRID DISSIPATION (AVG.)	10 MAX. WATTS

TYPICAL OPERATION			
D-C Plate Voltage	10	15	20 kilovolts
D-C Screen Voltage	1.5	1.5	1.5 kilovolts
D-C Grid Voltage	-450	-490	-525 volts
Pulse Plate Voltage	8.25	13.25	18.25 kilovolts
Peak Pulse Current	3.5	3.5	3.5 amperes
Pulse Screen Current	0.40	0.40	0.40 ampere
Pulse Grid Current	0.06	0.06	0.06 ampere
Pulse Pos. Grid Voltage	60	60	60 volts
Pulse Drive Power	31.0	33.0	35.0 watts
Pulse Plate Input Power	35.0	52.5	70.0 kilowatts
Pulse Plate Output Power	29.0	46.5	64.0 kilowatts
Duty	5.5	5.5	5.5 percent

RADIO-FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR*

MAXIMUM RATINGS	
PEAK D-C PLATE VOLTAGE	15 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK CATHODE CURRENT**	5.4 MAX. AMPERES
PLATE DISSIPATION (AVG.)	400 MAX. WATTS
SCREEN DISSIPATION (AVG.)	35 MAX. WATTS
GRID DISSIPATION (AVG.)	10 MAX. WATTS

*When used as a R-F Plate-and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid over-heating this element during the inter-pulse periods.

TYPICAL OPERATION			
Pulse Plate Voltage	10	12.5	15 kilovolts
Pulse Screen Voltage	1.5	1.5	1.5 kilovolt
D-C Grid Voltage	-725	-750	-785 volts
Pulse Plate Current**	0.87	0.87	0.87 ampere
Pulse Screen Current	70	70	70 ma
Pulse Grid Current	10	10	10 ma
Peak R-F Grid Voltage	845	870	905 volts
Pulse Drive Power	8.5	8.7	9.0 watts
Pulse Plate Input Power	8.7	11.0	13.0 kilowatts
Pulse Plate Output Power	6.8	8.8	10.5 kilowatts
Duty	20	18	16 percent

RADIO-FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	10 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	-1.0 MAX. KILOVOLT
PEAK CATHODE CURRENT**	5.4 MAX. AMPERES
PLATE DISSIPATION (AVG.)	400 MAX. WATTS
SCREEN DISSIPATION (AVG.)	35 MAX. WATTS
GRID DISSIPATION (AVG.)	10 MAX. WATTS

TYPICAL OPERATION			
D-C Plate Voltage	5	7.5	10 kilovolts
D-C Screen Voltage	1.5	1.5	1.5 kilovolts
D-C Grid Voltage	-680	-700	-725 volts
Pulse Plate Current**	0.87	0.87	0.87 ampere
Pulse Screen Current	70	70	70 ma
Pulse Grid Current	10	10	10 ma
Peak R-F Grid Voltage	800	820	845 volts
Pulse Drive Power	8.0	8.2	8.5 watts
Pulse Plate Input Power	4.3	6.5	8.7 kilowatts
Pulse Plate Output Power	2.7	4.7	6.6 kilowatts
Duty	25	22	19 percent

** The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the d-c plate current component during the pulse.

APPLICATION

MECHANICAL

Mounting— The 4PR400A must be operated vertically, base up or down. When the SK-410 Air-System Socket is used in conjunction with the SK-406 Air Chimney, the socket must be mounted to the under surface of the chassis to maintain proper air space between the plate seal and the chimney opening, otherwise plate seal cooling will be seriously impaired.

In the event the SK-410 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers.

Cooling— Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 200° C and 225° C, respectively. In all classes of operation it is recommended that a heat-radiating connector, the Eimac HR-6 or equivalent, be installed on the anode terminal, and that a socket and chimney be employed which provides for proper seal cooling. When the Eimac 4PR400A is operated at d-c or low frequencies in an Eimac SK-410 Air System Socket, complete with SK-406 Air Chimney and HR-6 Heat Radiator, the minimum airflow requirements to maintain seal temperatures at 200° C in 50° C inlet air are tabulated:

	Sea Level		10,000 Feet	
Ave. Plate Dissipation (watts)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)
200	6.5	0.045	9.5	0.063
300	8.5	0.076	12.5	0.110
400	10.5	0.125	15.5	0.180

When the Eimac 4PR400A is used as a pulsed-amplifier or oscillator at frequencies above 30 Mc, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by r-f charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature-sensitive paint.

ELECTRICAL

Filament Voltage— For maximum tube life the filament voltage, as measured directly at the filament pins, should be 5.0 volts. Variations in filament voltage must be kept within the range of 4.75 to 5.25 volts.

When the 4PR400A is utilized in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

Element Dissipation— Under normal operating conditions, the average plate dissipation of the 4PR400A should not be allowed to exceed 400 watts. Dissipation in excess of this maximum rating is permissable for short periods of time, such as during tuning procedures.

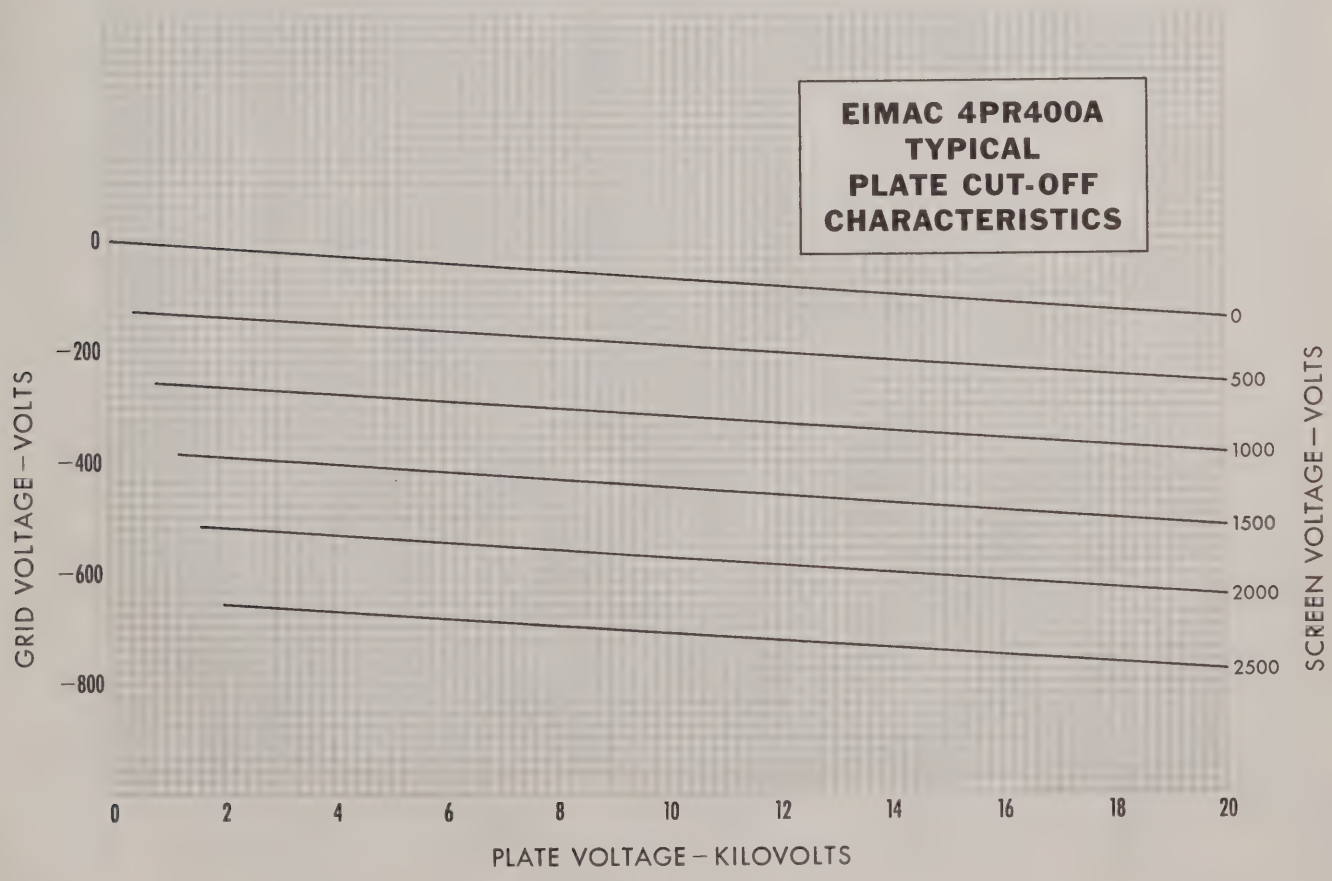
The average power dissipated by the screen-grid and the control-grid must not exceed 35 watts and 10 watts, respectively.

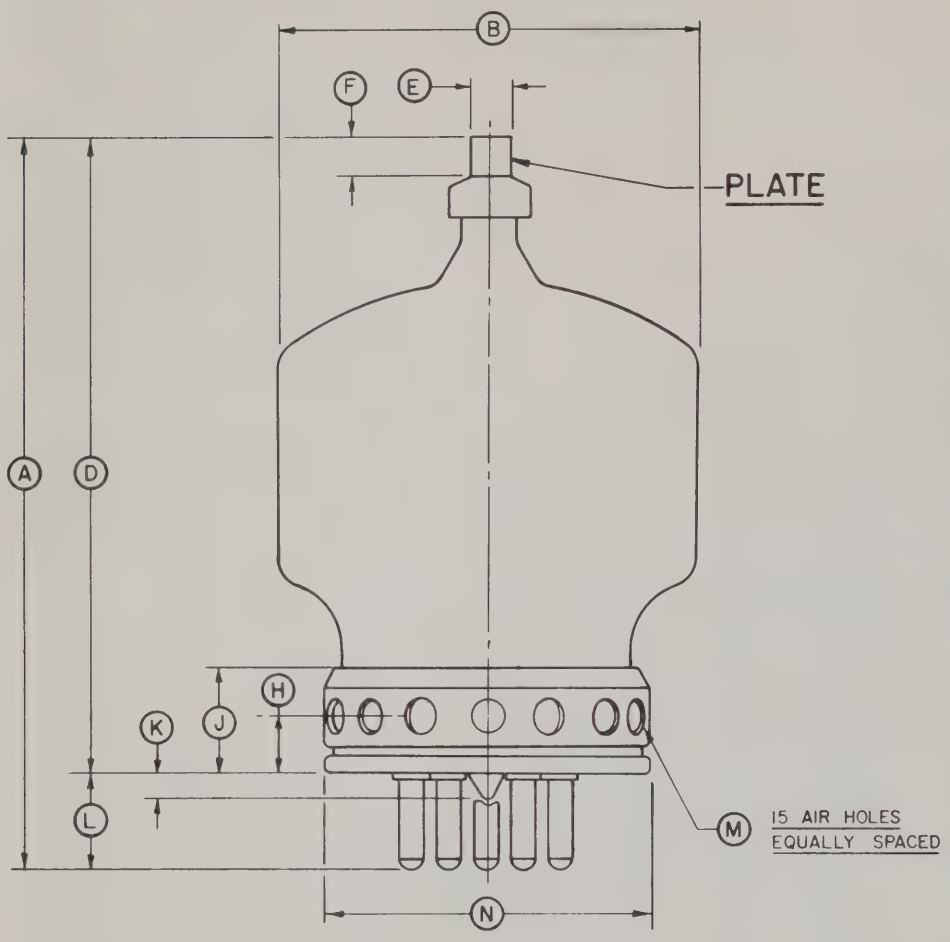
Cut-Off Characteristics— The Plate Current Cut-Off Characteristics of the 4PR400A are shown in the graph below. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristics closely approximate the mean value in the tube test specification.

Each 4PR400A is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 20 KV, a screen voltage of 1.5 KV, with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 675 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between -500 volts and -650 volts.

Pulse-Modulator Service— The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage waveform, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate wave form is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

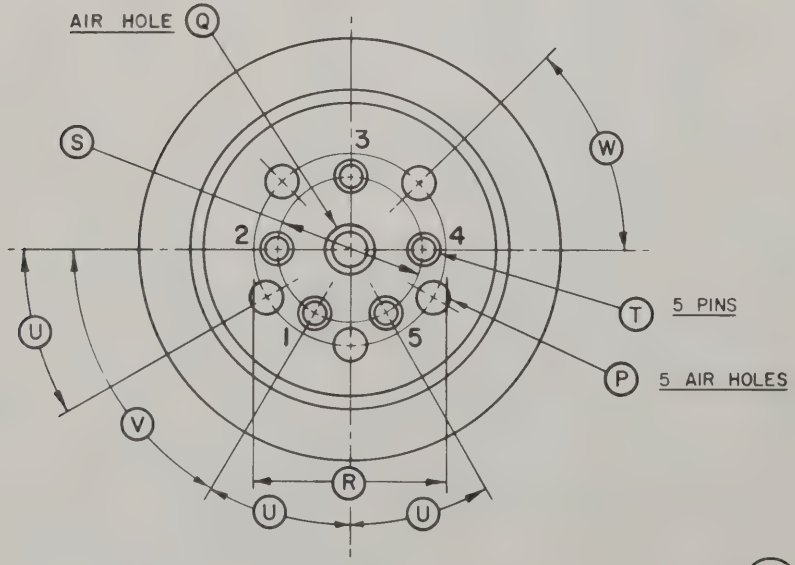
Special Applications— If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.



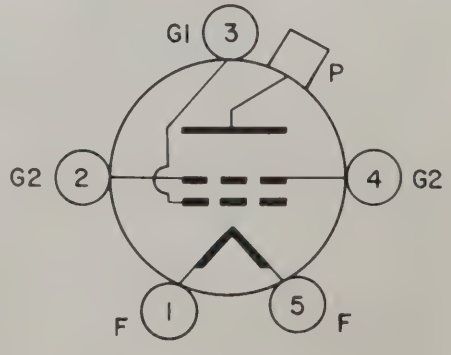


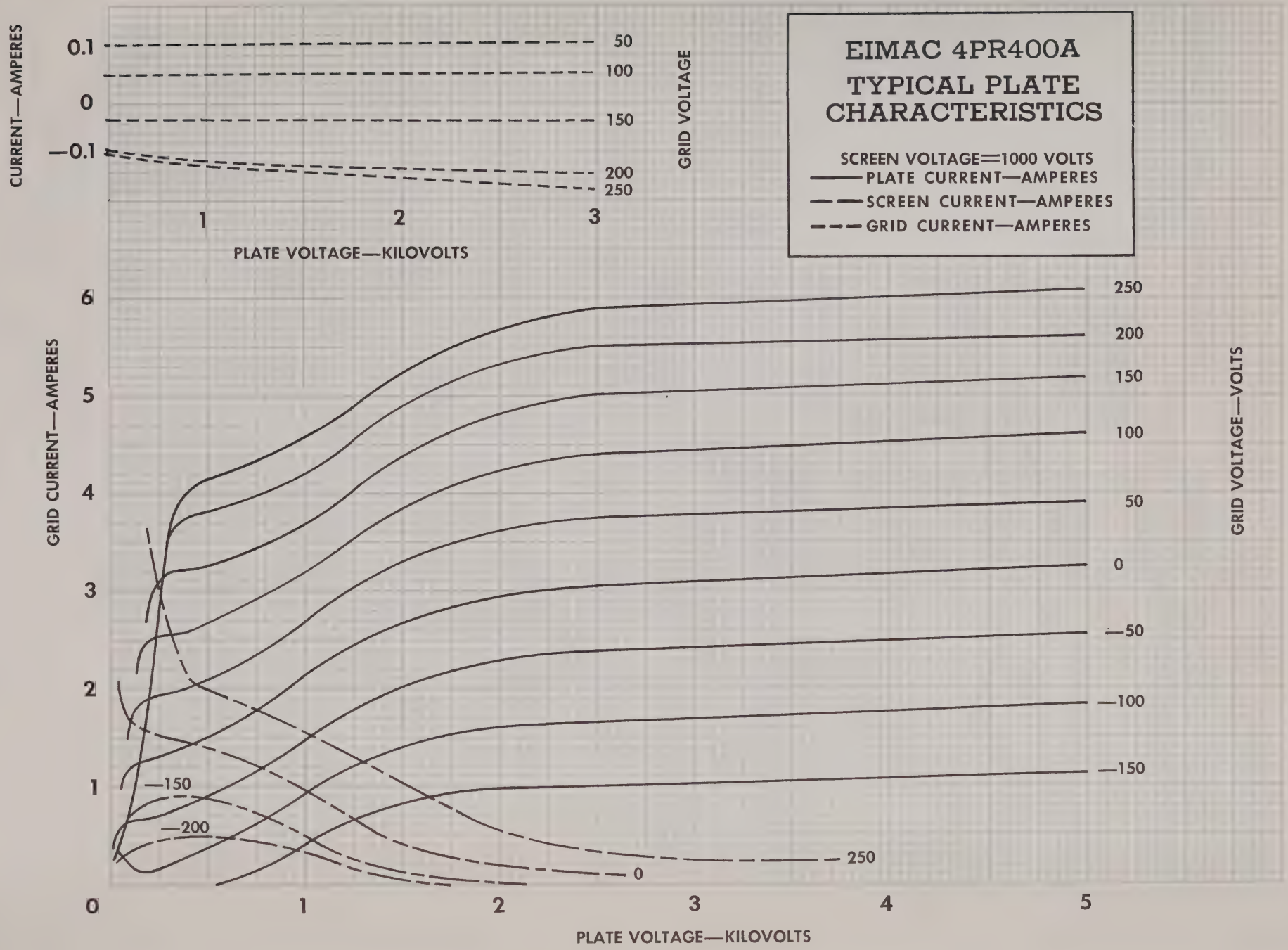
DIMENSIONS IN INCHES

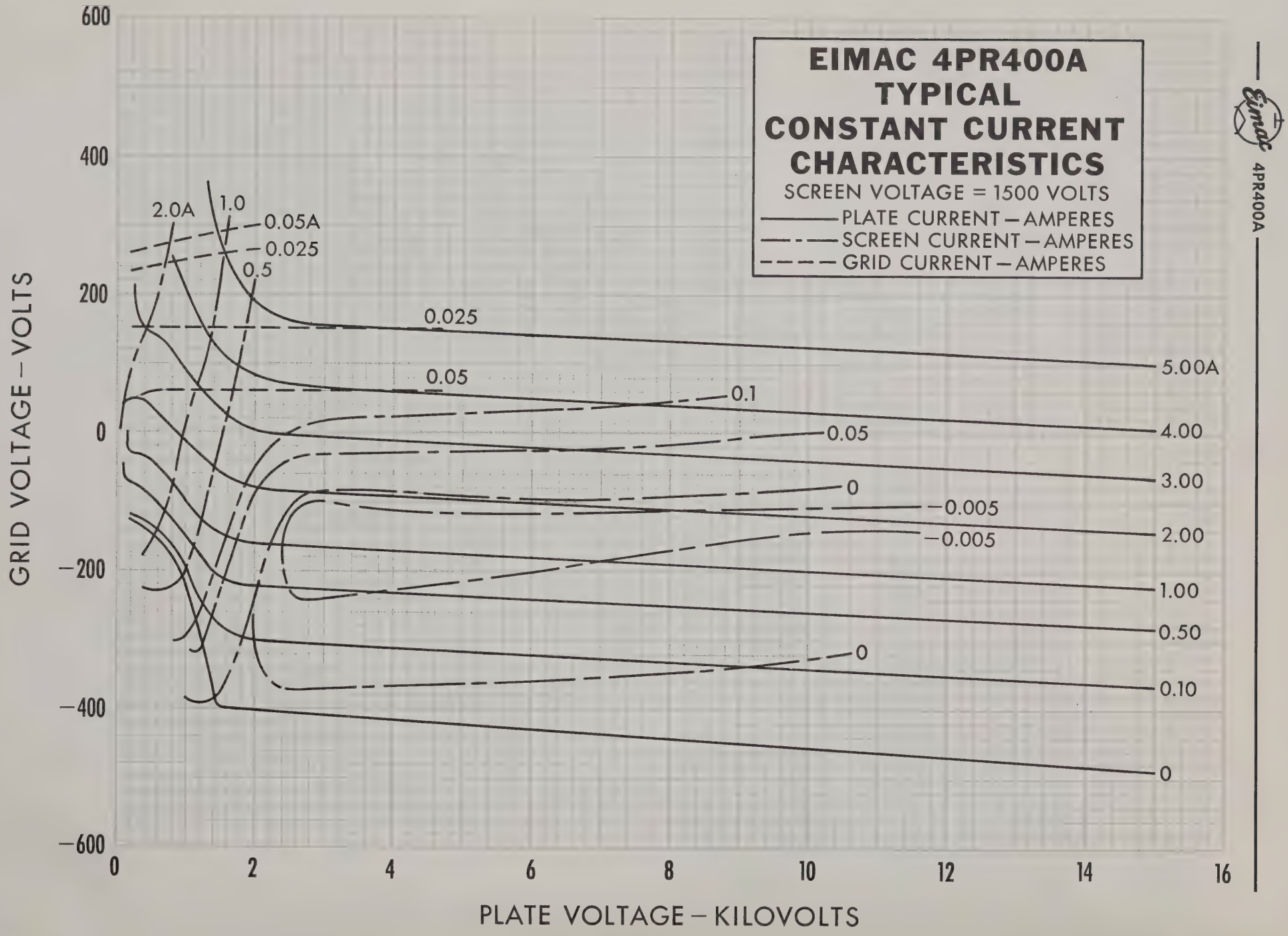
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	5-7/8	6-3/8	
B		3.9/16 D.	
D	5 - 1/8	5-5/8	
E	.350 DIA.	.365 DIA.	
F	21/64		
H			7/16
J		31/32	
K		1/4	
L			3/4
M			1/4 D.
N		2-3/4 D.	
P			5/16 D.
Q			1/2 D.
R			1-5/8 D.
S			1-1/4 D. P.C.
T	.185 DIA.	.191 DIA.	
U			30°
V			60°
W			45°



BOTTOM VIEW




EIMAC 4PR400A
TYPICAL PLATE
CHARACTERISTICS
SCREEN VOLTAGE=1000 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
CURRENT—AMPERES
0.1
0
—0.1
50
100
150
200
250
GRID VOLTAGE
1
2
3
PLATE VOLTAGE—KILOVOLTS
GRID CURRENT—AMPERES
6
5
4
3
2
1
0
250
200
150
100
50
0
—50
—100
—150
—150
—200
0
250
GRID VOLTAGE—VOLTS
0
1
2
3
4
5
PLATE VOLTAGE—KILOVOLTS


EIMAC 4PR400A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
12
14
16
2.0A
1.0
0.05A
0.025
0.5
0.025
0.05
0.1
0.05
0
0.005
0.005
0
5.00A
4.00
3.00
2.00
1.00
0.50
0.10
0

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

8189
4PR1000A

RADIAL-BEAM PULSE TETRODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 8189/4PR1000A is a pulse tetrode intended for use in pulse-modulator, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a Pyrovac plate and non-emitting grids, is recommended for use in new equipments where high voltage, high current, or high duty factor is encountered.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the Eimac SK-510 Air-System Socket and the SK-506 Air Chimney.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage	-	7.5		volts
Current	20.0		22.7	amperes
Amplification Factor (Grid to Screen)	-	6.9		
Direct Interelectrode Capacitances, Grounded Cathode:†				
Grid-Plate	-	-	0.35	uuf
Input	23.8		32.4	uuf
Output	6.8		9.4	uuf
Transconductance (I_b=300 ma)	-	10,000		umhos
Highest Frequency for Maximum Ratings	-	-	110	mc

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommend Socket	Eimac SK-510 Air-System Socket
Operating Position	Vertcial, base down or up
Maximum Operating Temperatures:	
Base Seals	150°C
Plate Seal	200°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	Eimac HR-8
Maximum Over-all Dimensions:	
Length	9.63 inches
Diameter	5.25 inches
Net Weight (tube only)	1.5 pounds
Shipping Weight	12 pounds

†In Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

D-C PLATE VOLTAGE	30 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK PLATE CURRENT	8.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	20	25	30 Kilovolts
D-C Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—335	—360	—380 Volts
Pulse Plate Voltage	17.7	22.7	27.7 Kilovolts
Peak Plate Current	8.0	8.0	8.0 Amperes
Pulse Screen Current	1.25	1.25	1.25 Amperes
Pulse Grid Current	0.2	0.2	0.2 Ampere
Pulse Pos. Grid Voltage	200	200	200 Volts
Pulse Drive Power	107	112	116 Watts
Pulse Plate Input Power	160	200	240 Kilowatts
Pulse Plate Output Power	140	180	220 Kilowatts
Duty	4.0	4.0	4.0 Percent

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RADIO-FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR*

MAXIMUM RATINGS	
PEAK D-C PLATE VOLTAGE	20 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK CATHODE CURRENT (Note 1)	12.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

*When used as a R-F Plate and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid overheating this element during the inter-pulse periods.

TYPICAL OPERATION			
Pulse Plate Voltage	10	15	20 Kilovolts
Pulse Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—480	—510	—535 Volts
Pulse Plate Current (Note 1)	1.95	1.95	1.95 Amperes
Pulse Screen Current	0.32	0.32	0.32 Ampere
Pulse Grid Current	0.02	0.02	0.02 Ampere
Peak R-F Grid Voltage	735	760	785 Volts
Pulse Drive Power	14.7	15.2	15.7 Watts
Pulse Plate Input Power	19.5	29.3	39.0 Kilowatts
Pulse Plate Output Power	17.0	23.0	31.5 Kilowatts
Duty	15.0	15.0	12.0 Percent

RADIO-FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	15 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK CATHODE CURRENT (Note 1)	12.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

TYPICAL OPERATION			
D-C Plate Voltage	10	12.5	15 Kilovolts
D-C Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—480	—495	—510 Volts
Pulse Plate Current (Note 1)	1.95	1.95	1.95 Amperes
Pulse Screen Current	0.32	0.32	0.32 Ampere
Pulse Grid Current	0.02	0.02	0.02 Ampere
Peak R-F Grid Voltage	735	745	760 Volts
Pulse Drive Power	14.7	15.0	15.2 Watts
Pulse Plate Input Power	19.5	24.4	29.3 Kilowatts
Pulse Plate Output Power	17.0	18.6	23.0 Kilowatts
Duty	15.0	15.0	15.0 Percent

Note 1: The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on an available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation sections refers to the d-c plate current component during the pulse.

APPLICATION

MECHANICAL

Mounting—The 4PR1000A must be operated vertically, base up or down. When the SK-510 Air-System Socket is used in conjunction with the SK-506 Air Chimney, the socket must be mounted to the under surface of the chassis to maintain proper air space between the plate seal and the chimney opening, otherwise plate seal cooling will be seriously impaired.

In the event the SK-510 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers.

COOLING—Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 150° C and 200° C, respectively. In all classes of operation it is recommended that a heat-radiating connector, the Eimac HR-8 or equivalent, be installed on the anode terminal, and that a socket and chimney be employed which provides for proper seal cooling. When the Eimac 4PR1000A is operated at d-c or low frequencies in an Eimac SK-510 Air System Socket, complete with SK-506 Air Chimney and HR-8 Heat Radiator, the minimum airflow requirements to maintain seal temperatures at 150° C in 50° C inlet air are tabulated below:

	Sea Level		10,000 Feet	
Ave. Plate Dissipation (watts)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)
600	17.0	0.30	24.0	0.45
800	20.0	0.40	28.0	0.56
1000	25.0	0.55	36.0	0.80

When the Eimac 4PR1000A is used as a pulsed-amplifier or oscillator at frequencies above 30 Mc, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by r-f charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature-sensitive paint.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins,

should be 7.5 volts. Variations in filament voltage must be kept within the range of 7.13 to 7.87 volts.

When the 4PR1000A is utilized in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

Element Dissipation—Under normal operating conditions, the average plate dissipation of the 4PR1000A should not be allowed to exceed 1000 watts. Dissipation in excess of this maximum rating is permissable for short periods of time, such as during tuning procedures.

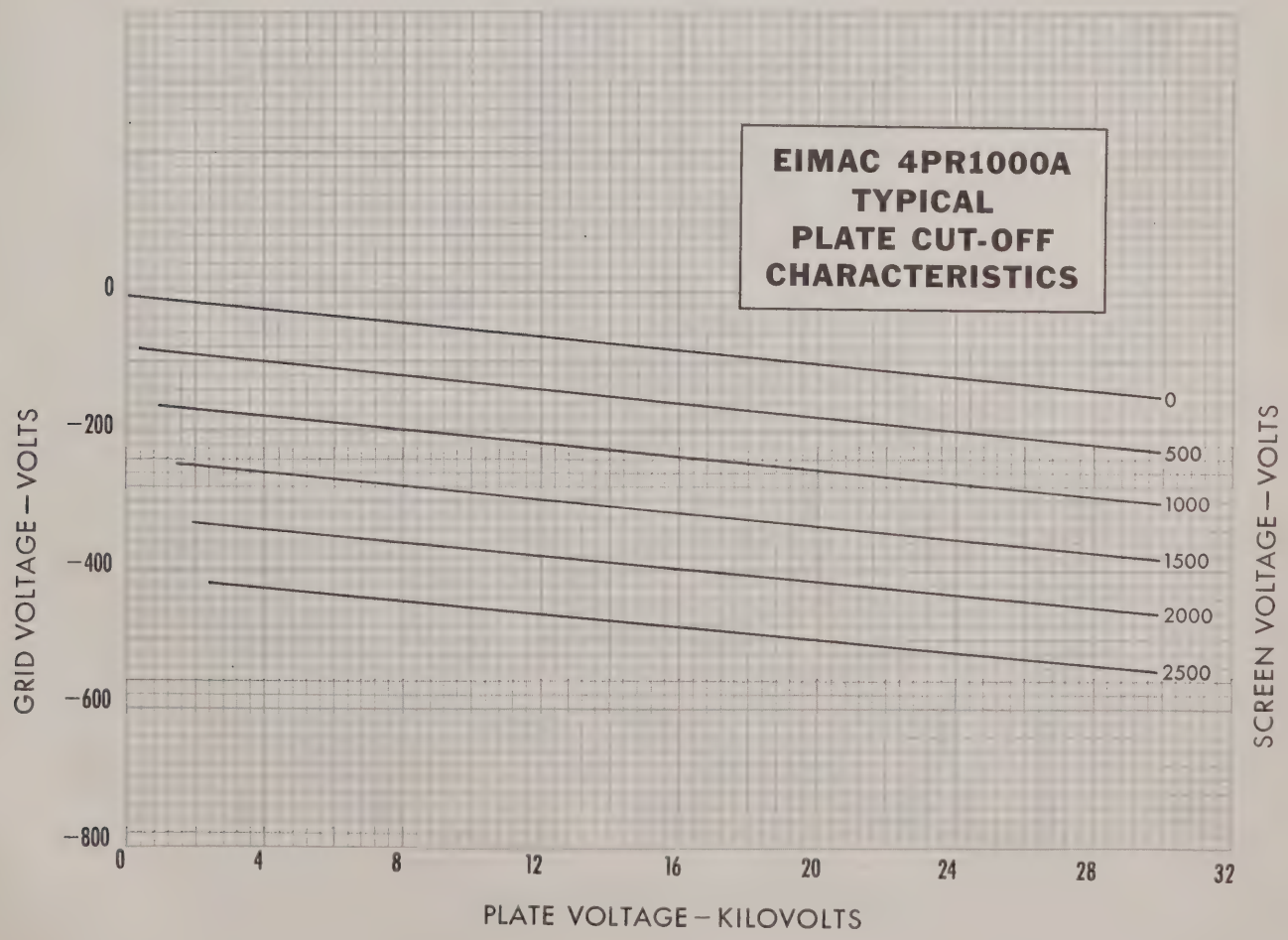
The average power dissipated by the screen-grid and the control-grid must not exceed 75 watts and 25 watts, respectively.

Cut-Off Characteristics—The Plate Current Cut-Off Characteristics of the 4PR1000A are shown in the graph below. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristics closely approximate the mean value in the tube test specification.

Each 4PR1000A is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 30 KV, a screen voltage of 2.5 KV with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 600 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between –470 volts and –585 volts.

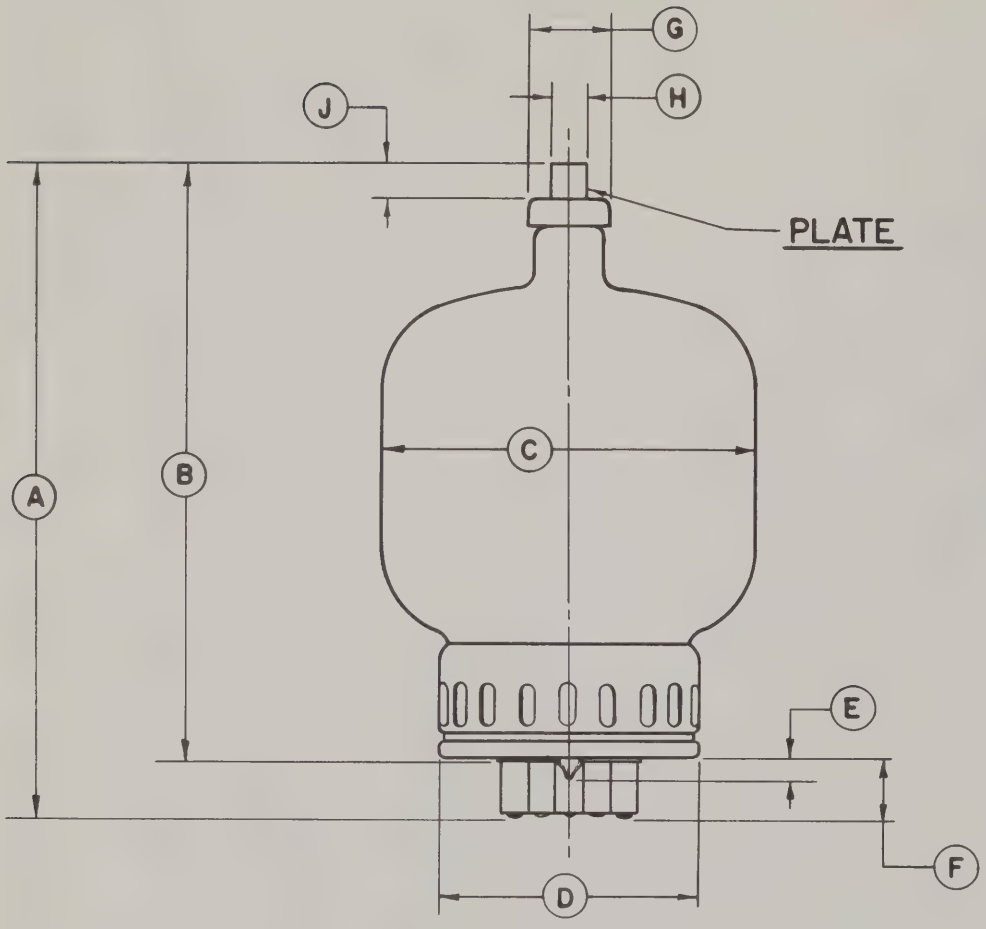
Pulse-Modulator Service—The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate waveform is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

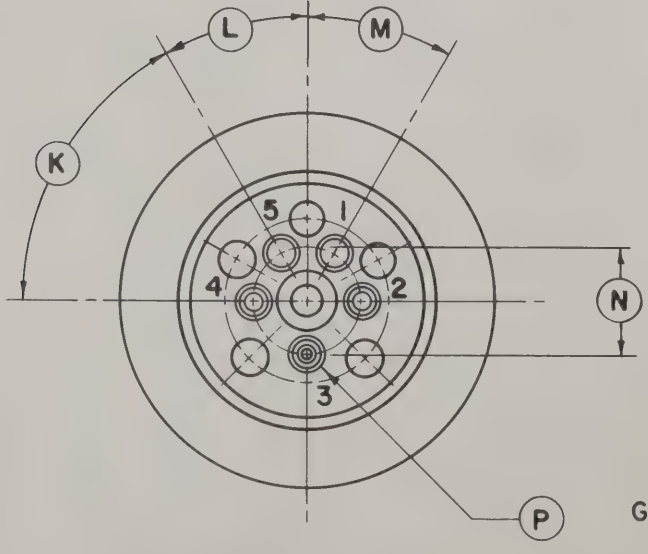
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, please write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.



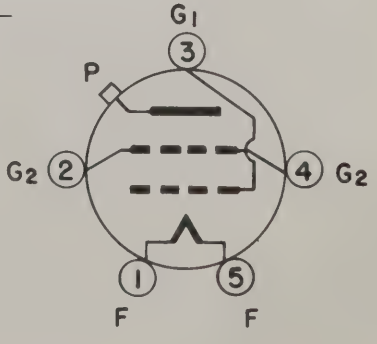
DIMENSIONS IN INCHES

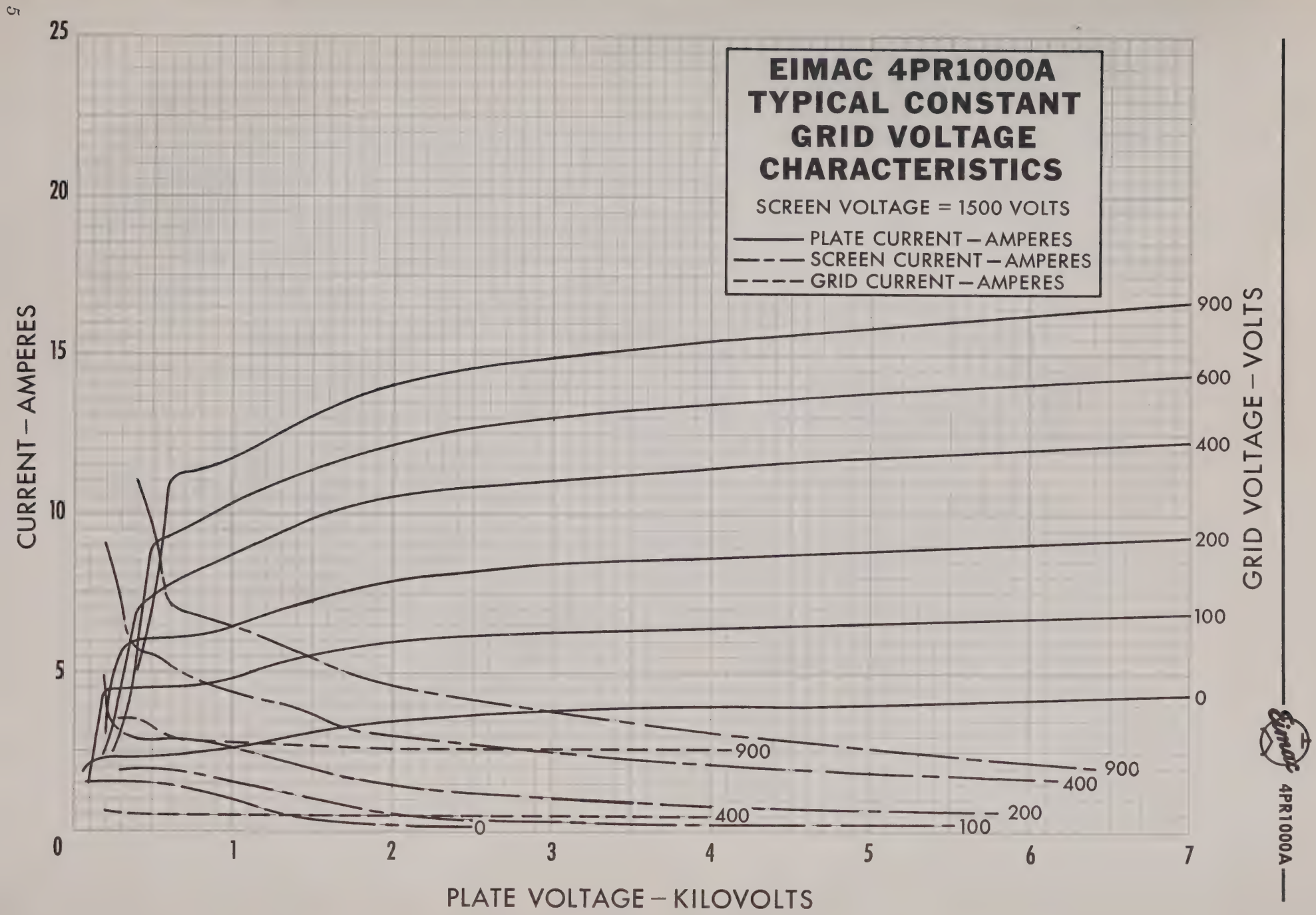
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	8.875	9.625	9.250
B	8.000	8.750	8.375
C		5.250	
D		3.625	
E		.313	
F	.825	.925	.875
G	1.110	1.140	1.250
H	.559	.573	.566
J	.484		
K			60°
L			30°
M			30°
N	1.495	1.505	1.500
P	.371	.377	.374

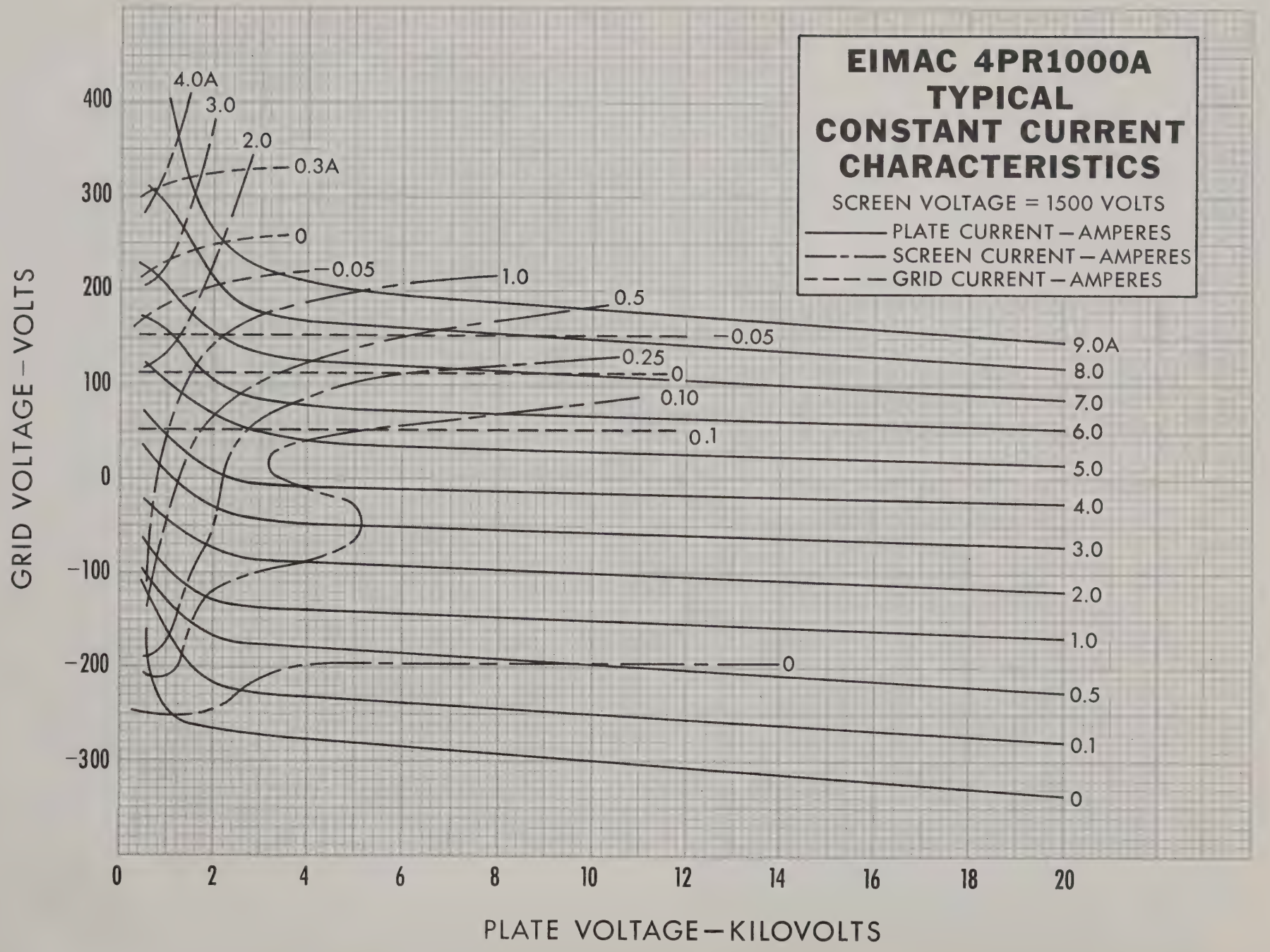




BOTTOM VIEW




EIMAC 4PR1000A
TYPICAL CONSTANT
GRID VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
CURRENT – AMPERES
PLATE VOLTAGE – KILOVOLTS
GRID VOLTAGE – VOLTS
0
5
10
15
20
25
1
2
3
4
5
6
7
900
600
400
200
100
0
900
400
200
100
0
900
400
Eimac 4PR1000A


EIMAC 4PR1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
400
300
200
100
0
−100
−200
−300
0
2
4
6
8
10
12
14
16
18
20
4.0A
3.0
2.0
0.3A
0
0.05
1.0
0.5
0.05
0.25
0
0.10
0.1
0
9.0A
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.1
0

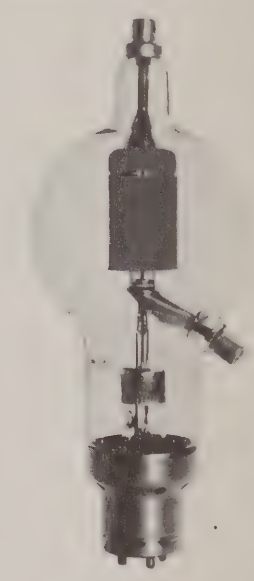
Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

6C21

PULSE TRIODE

MODULATOR AMPLIFIER



The Eimac 6C21 is a high-vacuum power triode designed for pulse-modulator service at d-c plate voltages up to 30 kilovolts and peak plate currents as high as 15 amperes.

The 6C21 is forced-air and radiation cooled, has a maximum plate-dissipation rating of 300 watts, and, in pulse modulator service, will deliver up to 375 kilowatts to a resistive load with 7.5 kilowatts of driving power.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	8.2 volts
Current	17.0 amperes
Amplification Factor (Average)	30
Direct Interelectrode Capacitances (Average)	
Grid-Plate	4.3 $\mu\mu$f
Input	9.5 $\mu\mu$f
Output	0.7 $\mu\mu$f
Transconductance (I_b=100 ma., E_b=2000v.)	6100 μmhos

MECHANICAL

Base	50-watt jumbo 4-pin
Connections	See drawing
Socket	E. F. Johnson Co. 123-211, National Co. XM-50 or equivalent.
Mounting Position	Vertical, base down or up
Cooling	Forced Air and Radiation
Maximum Temperature of Grid & Plate Seals	225° C.
Recommended Heat Dissipating Plate and Grid Connectors	Eimac HR-8
Maximum Overall Dimensions:	
Length	12-⅝ inches
Diameter	5-⅛ inches
Net Weight	1.3 pounds
Shipping Weight	5.8 pounds

MAXIMUM RATINGS

Pulse Modulator Service (Per Tube)

D-C PLATE VOLTAGE	30 MAX. KILOVOLTS
D-C GRID VOLTAGE	-2.0 MAX. KILOVOLTS
PEAK POSITIVE PLATE VOLTAGE	35 MAX. KILOVOLTS
PEAK POSITIVE GRID VOLTAGE	1.6 MAX. KILOVOLTS
PEAK PLATE CURRENT	15 MAX. AMPERES
AVERAGE GRID DISSIPATION	50 MAX. WATTS
AVERAGE PLATE DISSIPATON	300 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	28 kilovolts
D-C Grid Voltage	-1.5 kilovolts
Pulse Plate Current	15 amperes
Pulse Grid Current*	3.0 amperes
Pulse Positive Grid Voltage	1000 volts
Pulse Grid Driving Power*	7.5 kilowatts
Load: Resistive	1650 ohms
Duty	.002
Pulse Voltage Output	25 kilovolts
Pulse Power Input	420 kilowatts
Pulse Plate Dissipation	45 kilowatts
Pulse Power Output	375 kilowatts

*Approximate values.

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APPLICATION

Mounting—The 6C21 must be mounted vertically, base down or up. The leads to the plate and grid terminals should be flexible, and the tube must be protected from vibration and shock.

Cooling—Forced-air cooling of the filament stem structure is required. Base cooling requires a minimum air flow of 2½ cubic feet per minute directed through the tube base toward the filament press. If the hole in the socket is at least 1 inch in diameter and the manifold is the same diameter, a static pressure of ¼ inch of water is required at the manifold to provide the 2½ cubic feet per minute. Heat Dissipating Connectors (Eimac HR-8 or equivalent) must be used at the plate and grid terminals and unobstructed circulation of air around the tube is required in sufficient quantity to prevent the temperatures of grid and plate seals from exceeding 225°C. Forced ventilation of compartments or equipment in which the tube is located is always beneficial, though not necessarily required.

Tube temperatures may be measured with the aid of "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N. Y. For satisfactory results, Tempilaq must be sprayed on the surface to be measured in a thin coat, covering as small an area as will serve the purpose.

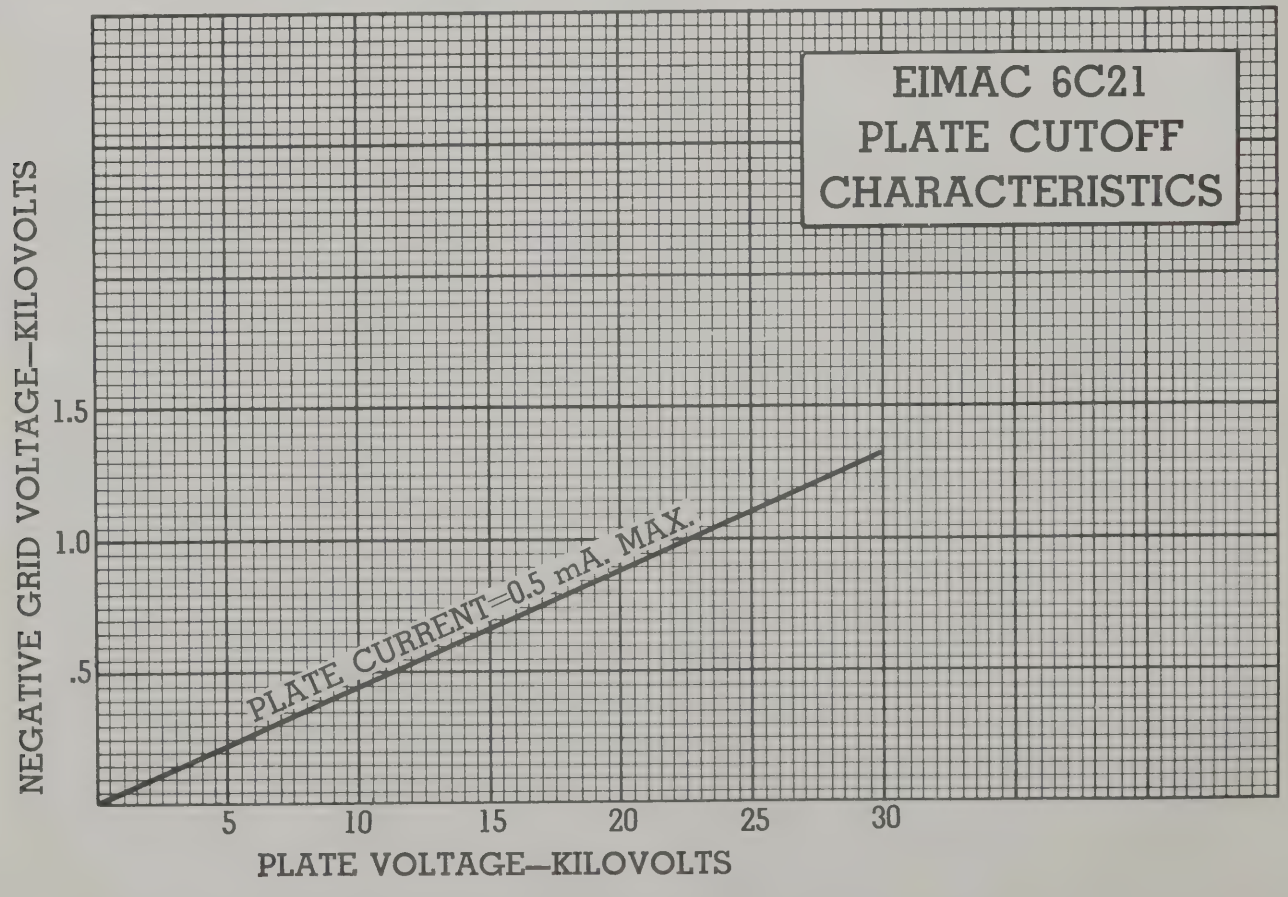
ELECTRICAL

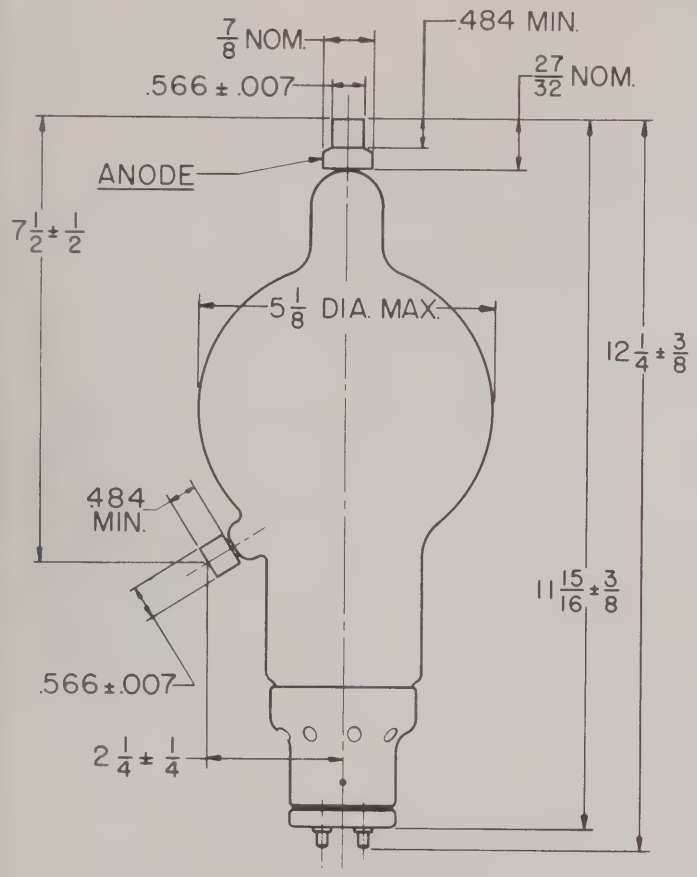
Filament Voltage—For optimum tube life the filament voltage, as measured directly at the base pins, should be the rated value of 8.2 volts. Variations should be kept within the range of 7.9 to 8.5 volts. All four socket terminals should be used, with two placed in parallel for each filament connection.

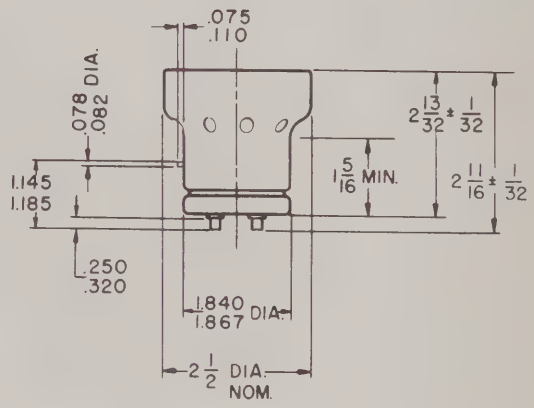
Plate Dissipation—Under normal operating conditions, the plate dissipation should not be allowed to exceed the maximum rating of 300 watts. Plate dissipation in excess of the maximum rating is permissable for short periods of time, such as during adjustment procedures.

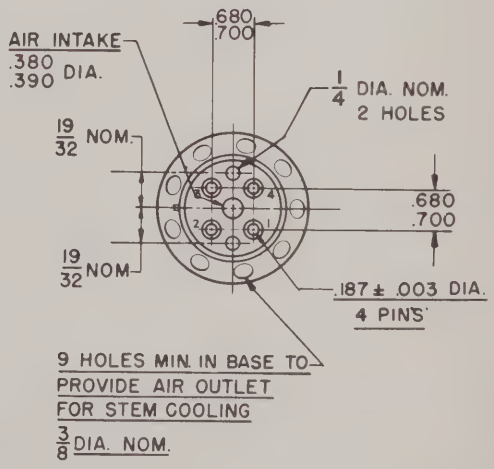
Operation—The 6C21 may be operated with inductive or resistive loads, provided only that the maximum ratings are not exceeded. The ratings listed for pulse modulator service are for operation at peak plate currents of 15 amperes and pulse lengths up to 100 milliseconds. Further information on pulse operation, such as tube limitations under long (100 milliseconds or more) pulse conditions, is contained in "Pulse Service Notes" obtainable from Eitel-McCullough, Inc., on request. If it is desired to operate the 6C21 under conditions widely different from those given for pulse modulator service, write Eitel-McCullough, Inc., for information and recommendations.

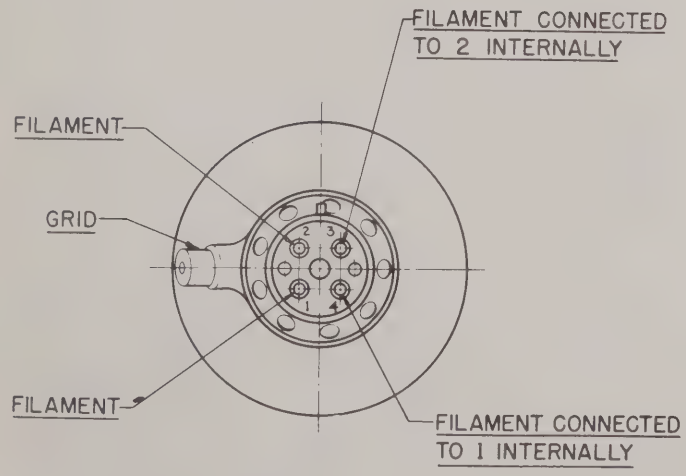
Useful information about pulse circuits may be obtained from such publications as "Pulse Generators", volume 5 of the MIT Radiation Laboratory Series, published by McGraw-Hill, 1948.









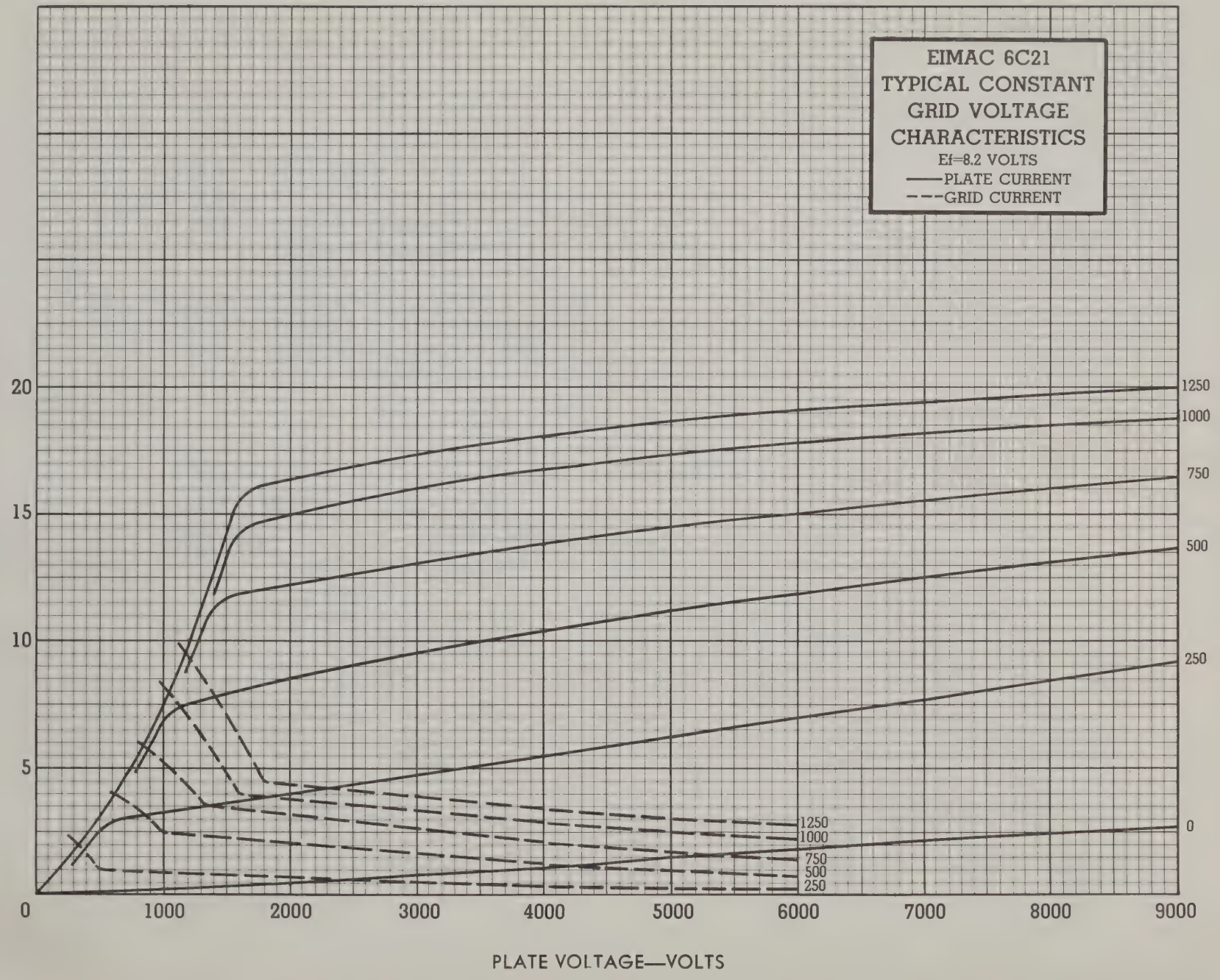


ON FINISHED TUBE ADD .060 MAX.
FOR SOLDER

BOTTOM VIEW

BASE DETAIL

DIMENSIONS
IN INCHES



Printed in U.S.A. 917

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

KY21A

GRID-CONTROLLED MERCURY-VAPOR RECTIFIER



The Eimac KY21A is a grid-controlled mercury vapor-rectifier incorporating features which enable it to withstand high peak inverse voltages and to conduct at relatively low applied voltages. The oxide-coated, edgewise-wound, shielded ribbon filament, provides a large emission reserve and long life.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated		
Voltage	2.5	volts
Current	10	amperes
Tube Voltage Drop (approx.)	10	volts
Ionization Time (approx.)	10	usec
Deionization Time (approx.)	100	usec

MECHANICAL

Base	Medium, 5-pin, #A5-11	
Recommended Socket	E. F. Johnson #122-225	
Maximum Overall Dimensions:		
Length	8.0	inches
Diameter	2 1/16	inches
Net Weight	4	ounces
Shipping Weight	3	pounds

MAXIMUM RATINGS (Single tube)

PEAK INVERSE ANODE VOLTAGE*	11,000 MAX.	VOLTS
PEAK ANODE CURRENT	3 MAX.	AMPERES
AVERAGE ANODE CURRENT	.75 MAX.	AMPERES
SUPPLY FREQUENCY	150 MAX.	CPS
CONDENSED-MERCURY TEMPERATURE RANGE**	20-60°	CENTIGRADE

* Temperatures in excess of 60°C limit the peak-inverse rating to 5500 volts with a corresponding reduction in permissible RMS supply voltages to one-half those listed in the table.

** Operation at 40° plus or minus 5°C is recommended.

APPLICATION

MECHANICAL

Mounting: The KY21A must be mounted vertically, base down. In order to carry the ten amperes of filament current the adjacent pins have been connected in parallel within the base. Similar connections should be made in the socket.

Cooling: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury in the KY21A should be kept within the ranges given under "MAXIMUM RATINGS".

This temperature should be maintained at 40° ±5°C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recommended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube.

ELECTRICAL

Filament Voltage: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 2.5 volts. Unavoidable variations in filament voltage must be kept within

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the range of 2.4 to 2.6 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombardment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.

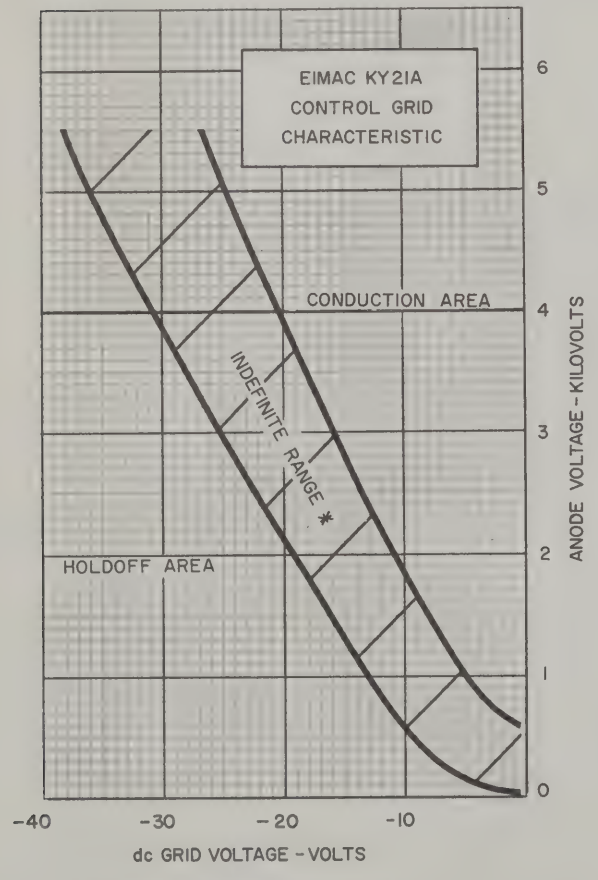
Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.

The filament of the KY21A should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 30 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.

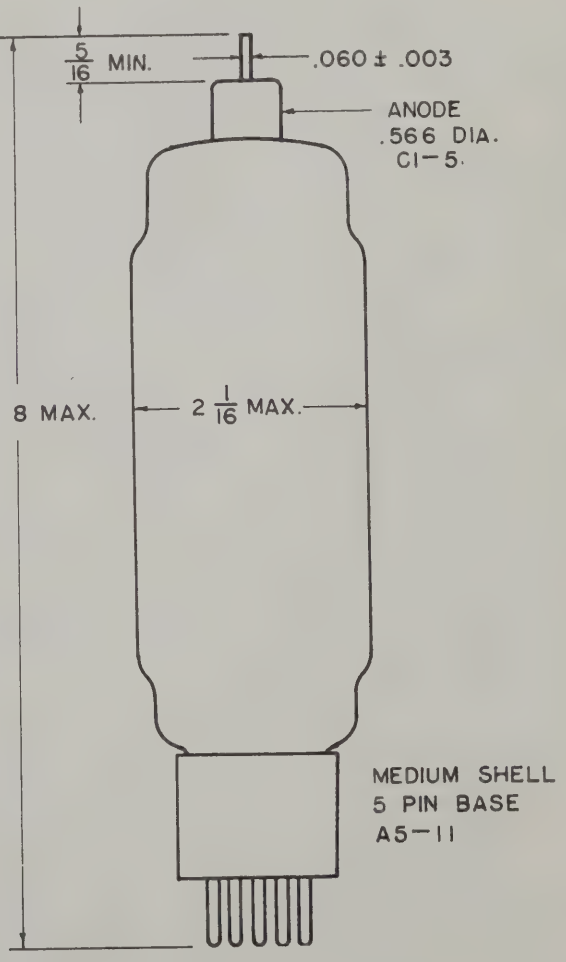
When it is necessary to use a shield around the KY21A care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When a KY21A is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.

Shielding: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the KY21A should be isolated from such fields as exist around a transmitter or other similar equipment.

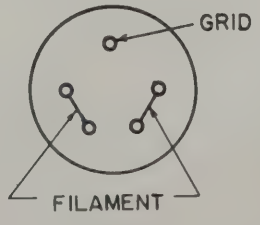
Grid Circuit: The KY21A is prevented from conducting by placing a negative potential on the grid. The relationship between negative grid control voltage and anode voltage is shown in the characteristic curve below.



* Depends on temperature, age and tube-to-tube variation.



NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with Eitel-McCullough, Inc.



RX21A

MERCURY-VAPOR RECTIFIER

EITEL-McCULLOUGH, INC.



The Eimac RX21A is a half-wave mercury vapor-rectifier incorporating features which enable it to withstand high peak inverse voltages and to conduct at relatively low applied voltages. The oxide-coated, edgewise-wound, shielded ribbon filament, provides a large emission reserve and long life.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Oxide-coated		
Voltage	2.5	volts
Current	10	amperes
Tube Voltage Drop (approx.)	10	volts

MECHANICAL

Base	Medium, 5-pin, #A5-11	
Recommended Socket	E.F. Johnson #122-225	
Maximum Overall Dimensions:		
Length	8.0	inches
Diameter	2-1/16	inches
Net Weight	4	ounces
Shipping Weight	3	pounds

MAXIMUM RATINGS (Single tube)

PEAK INVERSE ANODE VOLTAGE*	11,000 MAX. VOLTS
PEAK ANODE CURRENT	3 MAX. AMPERES
AVERAGE ANODE CURRENT	.75 MAX. AMPERES
SUPPLY FREQUENCY	150 MAX. CPS
CONDENSED-MERCURY TEMPERATURE RANGE**	- 20-60° CENTIGRADE

* Temperatures in excess of 60° C limit the peak-inverse rating to 5500 volts with a corresponding

** Operating at 40 plus or minus 5 C is recommended.

APPLICATION

MECHANICAL

Mounting: The RX21A must be mounted vertically, base down. In order to carry the ten amperes of filament current the adjacent pins have been connected in parallel within the base. Similar connections should be made in the socket.

Cooling: Provisions should be made for adequate air circulation around the tube. The temperature of the condensed mercury in the RX21A should be kept within the ranges given under "MAXIMUM RATINGS".

This temperature should be maintained at 40° ±5°C for most satisfactory operation of the tube. To measure the condensed-mercury temperature a thermocouple or small thermometer may be attached to the glass near the tube base using a small amount of putty. A condensed-mercury temperature lower than the recommended value raises the voltage at which the tube becomes conducting and tends to reduce the life of the filament. A temperature higher than recommended lowers the voltage at which the tube becomes conducting and reduces the peak inverse voltage rating of the tube.

ELECTRICAL

Filament Voltage: For maximum tube life, the filament voltage as measured directly at the filament pins, should be held at the rated value of 2.5 volts. Unavoidable variations in filament voltage must be kept within the range of 2.4 to 2.6 volts. A filament voltage less than the minimum recommended value may cause a high tube voltage drop, with consequent bombard-

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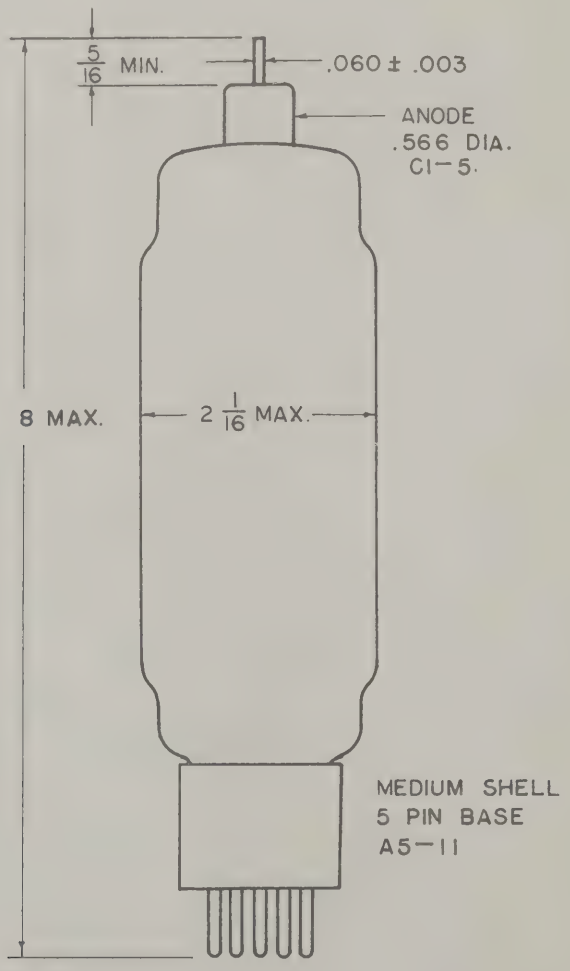
ment of the filament and eventual loss of emission. A filament voltage higher than the recommended maximum value will also decrease the life of the filament.

Caution should be observed in measuring the filament voltage as the filament circuit may be at a high dc potential.

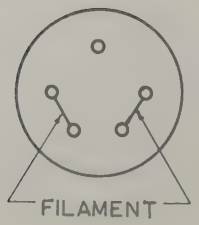
The filament of the RX21A should be allowed to reach operating temperature before the plate voltage is applied. Under normal conditions, a delay of approximately 30 seconds will be required. The delay time should be increased if there is any evidence of arc-back within the tube.

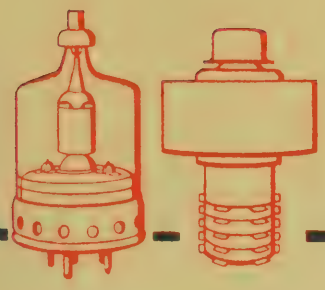
When it is necessary to use a shield around the RX21A care must be taken to insure adequate ventilation and maintenance of normal condensed-mercury temperature. When an RX21A is first installed, the filament should be operated at normal voltage for approximately ten minutes with no plate voltage applied, in order that the mercury may be properly distributed.

Shielding: Electromagnetic and electrostatic fields tend to cause the mercury vapor to break down, are detrimental to tube life and make proper operation difficult. Consequently, the RX21A should be isolated from such fields as exist around a transmitter or other similar equipment.



NOTE: These dimensions reflect standard manufacturing tolerances. They should not be made the basis for purchase specifications unless checked with Eitel-McCullough, Inc.





tetrodes · pentodes

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TECHNICAL DATA

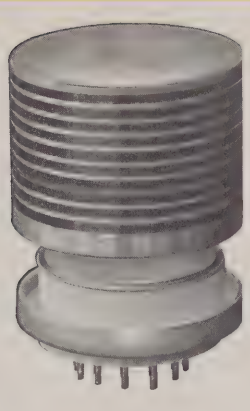
PRELIMINARY DATA

8072W
8121W
8122W

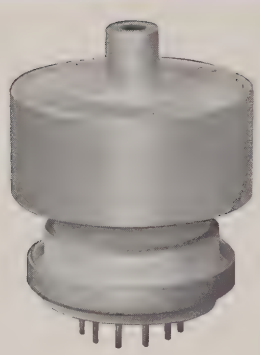
RADIAL-BEAM POWER TETRODES



8072W



8121W



8122W

The EIMAC 8072W, 8121W, and 8122W are compact external anode, ceramic/metal radial-beam tetrodes for use in rf power amplifier or oscillator service and linear rf power amplifier applications. The three types differ only in method of cooling and anode dissipation: the anode of the 8072W is designed for conduction cooling and is nominally rated for 100 watts; the 8121W anode has a transverse cooler for forced-air cooling and is rated for 150 watts; and the 8122W requires axial-flow forced-air cooling and is rated for 400 watts. The rugged construction of these tubes allows full-voltage operation under 50G, 11 millisecond shock conditions and vibrational stress of 10G up to 1000Hz. Each may be used as a direct replacement for its non-rugged prototype in most equipments.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater Voltage	13.5 ± 10%	V
Heater Current, at 13.5 volts	1.3	A
Cathode-Heater Potential, maximum	±150	V
Amplification Factor (Average):		
Grid to screen	11	
Transconductance (Average):		
$I_{b=}$ 200 mAdc, E_{c2} = 400 Vdc	25,000	μmhos
Direct Interelectrode Capacitance (Grounded Cathode) [2]		
Cin	36.5	pF
Cout	6.7	pF
Cgp	0.1	pF
Frequency of Maximum Rating:		
CW	500	MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association Standard RS-191.

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MECHANICAL

Maximum Overall Dimensions:

	TYPE 8072W	TYPE 8121W	TYPE 8122W
Length	2.260 in. 57.40 mm	2.196 in. 55.78 mm	2.260 in. 57.40 mm
Diameter	1.436 in. 36.47 mm	1.475 in. 37.46 mm	1.640 in. 41.66 mm
Net Weight	2.0 oz. 56.7 gm	3.25 oz. 92 gm	4.0 oz. 113 gm
Operating Position	Any	Any	Any

Cooling:

Type 8072W	Conduction Cooled
Type 8121W - Cooling Air Velocity Head Required (See COOLING-8121W Application Note)	0.25 In. H_2O
Type 8122W - Air flow at 50°C at sea level	9.0 ft^3/Min.
Press. Drop across anode cooler	0.5 In. H_2O

Operating Temperature, Maximum, all three types:

Ceramic/Metal Seals and Anode Core	250°C
Base: (all types)	Large Wafer Elevenar 11-Pin with Ring (JEDEC No. E11-81)
Recommended Sockets	E.F. Johnson #124-311-1 Erie #9802-000 Mycalex #CP464-2

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 13.5 volts	1.15	1.45	A
Cathode Warmup Time	60	---	sec.
Interelectrode Capacitances (Grounded Cathode) [1]			
Cin	33.0	40.0	pF
Cout	6.0	7.5	pF
Cgp	---	0.13	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association Standard RS-191.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy of FM Telephony

(Key-Down Conditions - Frequencies to 500 MHz)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2200	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.3	AMPERE
PLATE DISSIPATION (8072W) [1]	100	WATTS
(8121W)	150	WATTS
(8122W)	400	WATTS
SCREEN DISSIPATION	8	WATTS
GRID DISSIPATION	1	WATT

1. Higher dissipation obtainable depending on design of heat sink; see COOLING - 8072W

TYPICAL OPERATION (Frequencies to 50 MHz)

Plate Voltage	700	1000	1500	2000	Vdc
Screen Voltage	175	200	200	200	Vdc
Grid Voltage	-10	-30	-30	-30	Vdc
Plate Current	300	300	300	300	mAdc
Screen Current [1]	25	20	20	20	mAdc
Grid Current [1]	50	40	40	30	mAdc
Driving Power [1]	1.2	2.0	2.0	2.0	W
Useful Output Power [2]	120	175	275	375	W

1. Approximate value.

2. Delivered to the load.

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN Class AB_1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (to 30 MHz)	3000	VOLTS
(to 500 MHz)	2200	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.3	AMPERE
PLATE DISSIPATION (8072W)[1]	100	WATTS
(8121W)	150	WATTS
(8122W)	400	WATTS
SCREEN DISSIPATION	8	WATTS
GRID DISSIPATION	1	WATTS

1. Higher dissipation obtainable depending on design of heat sink; see COOLING - 8072W.

TYPICAL OPERATION (Frequencies to 30 MHz) Class AB_1
Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	700	1000	1500	2000	Vdc
Screen Voltage	250	250	250	400	Vdc
Grid Voltage[1]	-20	-20	-20	-35	Vdc
Zero-Signal Plate Current	100	100	100	100	mAdc
Single-Tone Plate Current[2]	205	210	210	335	mAdc
Two-Tone Plate Current	150	160	160	250	mAdc
Single-Tone Screen Current[3]	16	10	10	10	mAdc
Two-Tone Screen Current[3]	10	7	7	7	mAdc
Resonant Load Impedance	1420	2270	3800	3050	Ohms
Useful Output Power[4]	80	110	170	380	W

1. Adjust to specified zero-signal dc place current.
2. See ANODE CURRENT Application Note.
3. Approximate value.
4. Delivered to the load.

APPLICATION

MECHANICAL

MOUNTING & SOCKETING - The 8072W, 8121W, and 8122W may be mounted in any position. Sockets such as E.F. Johnson #124-311-1, Erie #9802-000, Mycalex #CP464-2, or equivalent may be used as long as there are no unusual circumstances which would allow the ceramic/metal base seal temperatures to exceed the rated maximum of 250°C. Mounting should be such that free movement of air past the base by convection is possible, or if forced-air cooling is being provided for the anode, some of this air may be bled off to provide for some circulation past the tube base.

The 8072W mounting is normally controlled by its heat-sink configuration and location. If air movement is restricted in the base area, the socket may also require coupling to a heat sink in order to limit base seal temperatures.

The 8121W has a transverse cooler on its anode, permitting forced-air cooling directed crossways. The 8122W requires axial-flow forced-air cooling for its anode, which can often be accomplished most easily be means of a pressurized anode-compartment chassis, with air passing through the anode cooler and then exhausting. In such an installation some air can usually be bled past the socket mount to provide for base cooling, if this is required.

ELECTRICAL

HEATER/CATHODE OPERATION - The rated heater voltage for the 8072W, 8121W, and 8122W is 13.5 volts as measured at the base of the tube, and variations should be restricted to plus or minus ten percent. In cases where long life and consistent performance are a prime consideration, the heater may be operated at a slightly reduced voltage and when this is done regulation is required to restrict variation. At frequencies above approximately 300 MHz it may be necessary to reduce heater voltage to compensate for rf transit-time heating of the cathode after dynamic operation of the tube has started. This back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. The following heater operating voltages are recommended for straight-through Class-C amplifier operation:

Frequency (MHz)	Heater Voltage
300 or lower	13.5
301 to 400	13.0
401 to 500	12.5

The potential between the heater and the cathode should be limited to ±150 Vdc.

COOLING (8072W) - This tube is designed for use in a conduction-cooled system where tube heat is transferred to a heat sink, which in turn may be cooled by natural (free) convection, forced-air convection, liquid cooling, or a combination of these methods. Anode dissipation is normally limited only by the allowable temperature rise for the seals and the anode core. The nominal dissipation rating of 100 watts may be realized with simple heat sink configurations; dissipation levels up to 300 watts are possible with more thorough designs, with the choice determined by the application. In all cases, however, the cooling system must maintain the anode and ceramic/metal seal temperatures below 250°C, and in cases where long life and consistent performance are factors, cooling in excess

of absolute minimum requirements is normally beneficial.

Intimacy of contact and pressure are two factors which will effect transfer of heat from the tube anode to the heat sink. A good thermally conductive compound should be used in the interface between the anode and the sink to reduce thermal resistance of the joint. Examples of commercially available thermal joint compound are:

WAKEFIELD 120-Wakefield Engineering Co., Wakefield, MA 01880.

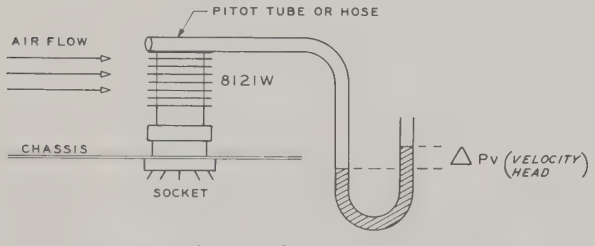
DOW CORNING 340-Dow Corning Corp., Midland, MI 48640

ASTRODYNE THERMAL BOND 312-Astrodyne Inc., Burlington, MA 01803

G.E. INSULGREASE G641-General Electric Co., Cleveland, OH 44117.

The designer is cautioned to allow for some movement in the socket mount to assure that the anode makes good contact to its heat sink without interference. If the tube anode and the sink are not making intimate contact, heat transfer will be seriously affected. The designer is encouraged to use temperature-sensitive paint or other temperature-sensing devices in connection with any equipment design before the layout is finalized.

COOLING (8121W) - Forced-air cooling must be provided to maintain the anode core and seal temperatures within the maximum rating. Because of the wide variation possible in the air source used, it is suggested that velocity head of the air



movement past the anode radiator be used as the criteria of sufficient flow, as shown in the accompying illustration. The tabulation shown for cooling air at both 25°C and 50°C is for sea level and will provide sufficient air to maintain anode core temperature below 225°C. At higher altitudes, additional air is required. For 10,000 feet, for example, the velocity head values will increase by a factor of 1.46.

Anode Diss.	25°C AIR Velocity Head (In. H_2O)	50°C AIR Velocity Head (In. H_2O)
60 W	0.020	0.035
100 W	0.055	0.107
150 W	0.14	0.25

COOLING (8122W) - Forced-air cooling must be provided to maintain the anode core and seal temperatures within the maximum rating. With an anode dissipation of 400 watts and an incoming air temperature of 50°C maximum at sea level, the anode core and seal temperature will be maintained at 225°C or less with an air flow of 9.0 cfm directed through the anode cooler in a base-to-anode direction.

The approximate pressure drop across the anode cooler with 9.0 cfm of air flow is 0.5 inch of water. It may be required that some air be bled past the socket for base cooling, either by means of somewhat oversize socket-mounting hole, or a series of small holes drilled in the chassis near the edges of the socket, in order to provide a small amount of air circulation around the base pins of the tube.

ANODE CURRENT - The 8072W, 8121W, and 8122W are rated for 300 mAdc of continuous anode current. During short periods of circuit adjustment under CW or single-tone conditions, the average anode current may be as high as 450 mAdc, but care must be taken to keep the time period when the current is above rating as brief as possible in order to prevent tube overheating.

HIGH VOLTAGE - The 8072W, 8121W, and 8122W operate at voltages which can be deadly and the equipment must be designed properly and operating precautions must be followed. Equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SHOCK AND VIBRATION - The EIMAC 8072W, 8121W, and 8122W are designed to operate under shock or vibration conditions capable of disabling a conventional tube of similar power capability. With high voltage typical of normal use applied, these tubes are designed to perform reliably under 50G, 11 millisecond shock conditions or vibrational stress of 10G to a frequency of 1000 Hz. The equipment designer is cautioned to provide adequate support for the tube to prevent relative motion between tube and socket in equipments where shock and vibration stresses are anticipated.

GRID OPERATION - The maximum rated dc grid bias voltage is -100 volts and the maximum grid dissipation rating is 1.0 watts. In normal applications the grid dissipation will not approach the maximum rating.

At operating frequencies above the 100 MHz region, driving-power requirements for amplifiers increase noticeably. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid current values below approximately 30 mAdc.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 25,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen grid is 8 watts, and the screen input power should be kept below this level. The product of peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode. A series regulator circuit can be used only when an adequate bleeder resistor is provided.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be on before screen voltage can be applied.

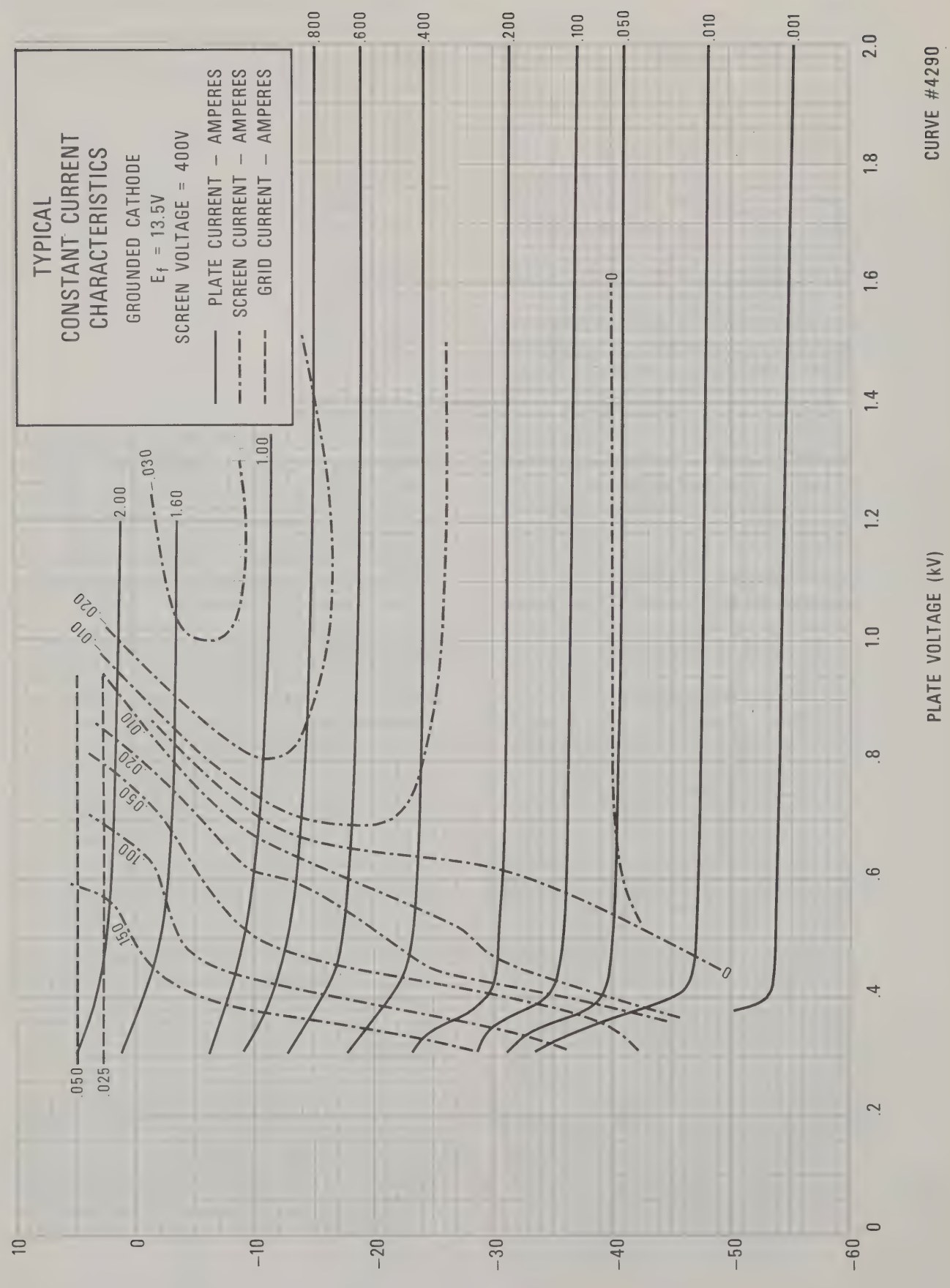
MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

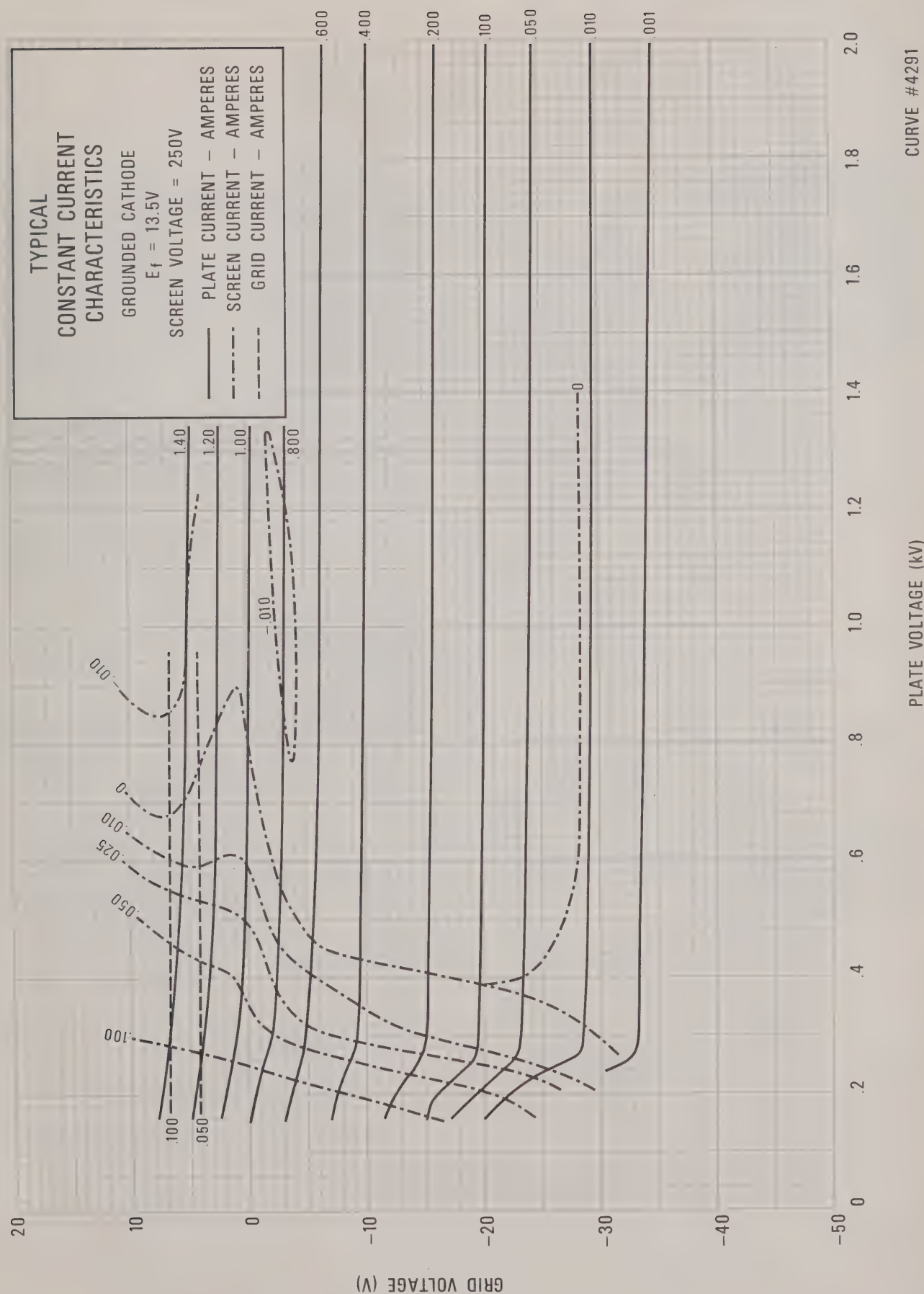
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event one tube fails.

VHF OPERATION - The 8072W, 8121W, and 8122W are suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is increased by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191. The equipment designer is therefore cautioned to make allowance for the additional capacitance values which will exist in any normal application. Actual measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

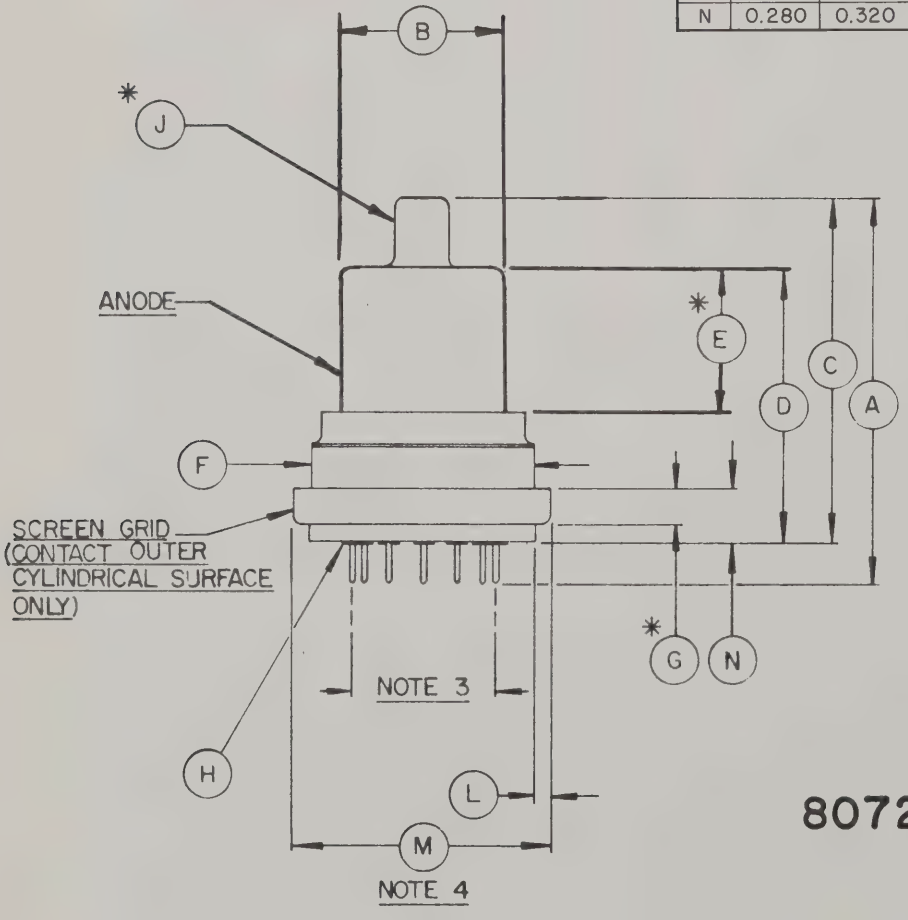
SPECIAL APPLICATIONS - If it is desired to operate any of these tubes under conditions widely different from those given here, write to Power Grid Division, Attention: Applications, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 13.5V
SCREEN VOLTAGE = 400V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
.800
.600
.400
.200
.100
.050
.010
.001
0
2.00
1.60
1.00
.030
.020
.010
.050
.025
GRID VOLTAGE (V)
10
0
−10
−20
−30
−40
−50
−60
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
PLATE VOLTAGE (kV)
CURVE #4290


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 13.5V
SCREEN VOLTAGE = 250V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
600
400
200
100
050
010
001
0
1.40
1.20
1.00
800
010
010
0
010
025
050
100
100
050
20
10
0
−10
−20
−30
−40
−50
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #4291

PIN NO. 1	CATHODE
PIN NO. 2	SCREEN GRID
PIN NO. 3	CONTROL GRID
PIN NO. 4	CATHODE
PIN NO. 5	HEATER
PIN NO. 6	HEATER
PIN NO. 7	SCREEN GRID
PIN NO. 8	CONTROL GRID
PIN NO. 9	CATHODE
PIN NO. 10	SCREEN GRID
PIN NO. 11	CONTROL GRID

DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	--	2.260	--	--	57.40	--
B	0.804	0.814	--	20.42	20.67	--
C	1.855	1.985	--	47.12	50.42	--
D	1.470	1.560	--	37.34	39.62	--
E	0.700	--	--	17.78	--	--
F	--	1.250	--	--	31.75	--
G	0.150	--	--	3.81	--	--
H	BASE: E11-81 (JEDEC DESIGNATION)					
J	CAP: C1-1 (JEDEC DESIGNATION)					
L	0.080	--	--	2.03	--	--
M	1.416	1.436	--	35.97	36.47	--
N	0.280	0.320	--	7.11	8.15	--

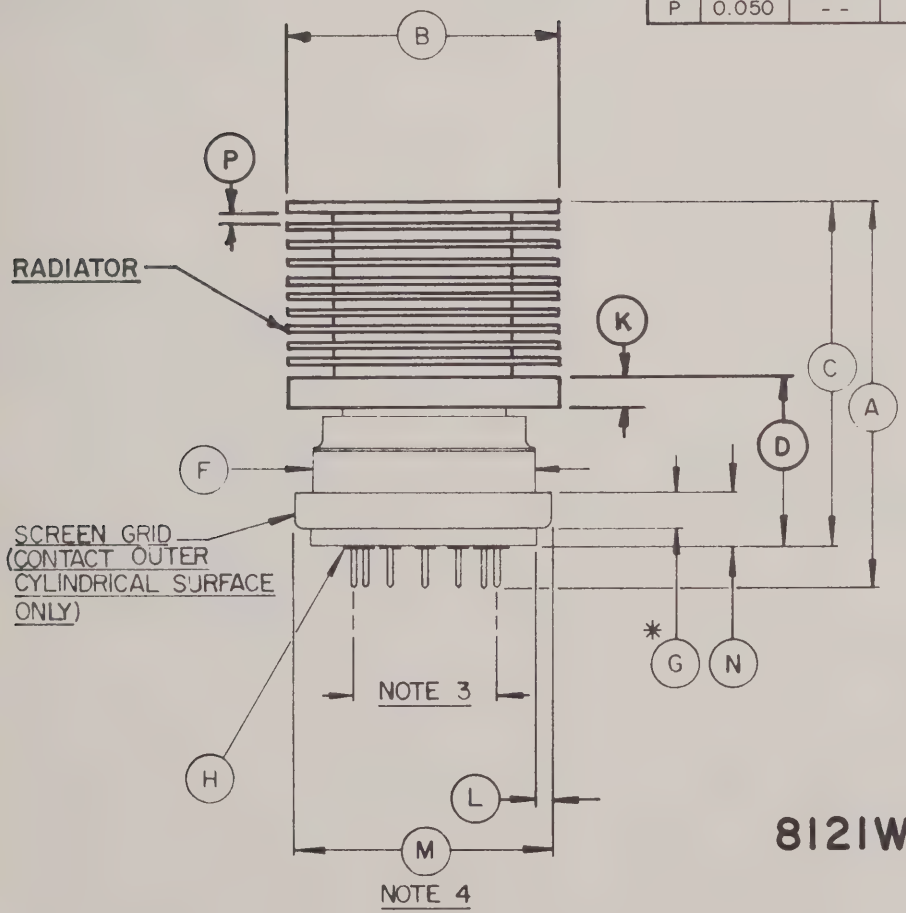


NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. DIM. M TO BE CONCENTRIC TO B & PIN PITCH DIA. WITHIN .030 DIA.

8072W

PIN NO. 1	CATHODE
PIN NO. 2	SCREEN GRID
PIN NO. 3	CONTROL GRID
PIN NO. 4	CATHODE
PIN NO. 5	HEATER
PIN NO. 6	HEATER
PIN NO. 7	SCREEN GRID
PIN NO. 8	CONTROL GRID
PIN NO. 9	CATHODE
PIN NO. 10	SCREEN GRID
PIN NO. 11	CONTROL GRID

DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	2.196	- -	- -	55.78	- -
B	1.445	1.475	- -	36.70	37.46	- -
C	1.785	1.915	- -	45.34	48.64	- -
D	0.860	0.980	- -	21.84	24.89	- -
F	- -	1.250	- -	- -	31.75	- -
G	0.150	- -	- -	3.81	- -	- -
H	BASE: E11-81 (JEDEC DESIGNATION)					
K	0.150	0.170	- -	3.81	4.32	- -
L	0.080	- -	- -	2.03	- -	- -
M	1.416	1.436	- -	35.97	36.47	- -
N	0.280	0.320	- -	7.11	8.13	- -
P	0.050	- -	- -	1.27	- -	- -

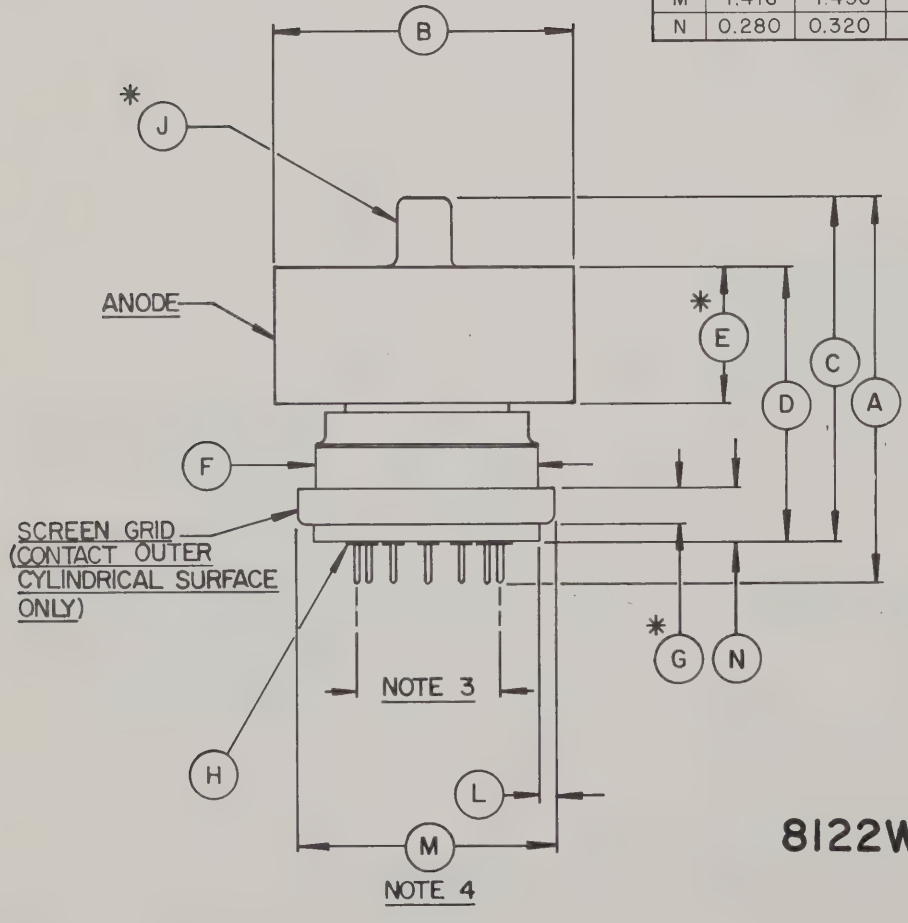


8121W

NOTES:
1. REF DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*)CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. DIM. M TO BE CONCENTRIC TO B & PIN PITCH DIA. WITHIN .030 DIA.

PIN NO. 1	CATHODE
PIN NO. 2	SCREEN GRID
PIN NO. 3	CONTROL GRID
PIN NO. 4	CATHODE
PIN NO. 5	HEATER
PIN NO. 6	HEATER
PIN NO. 7	SCREEN GRID
PIN NO. 8	CONTROL GRID
PIN NO. 9	CATHODE
PIN NO. 10	SCREEN GRID
PIN NO. 11	CONTROL GRID

DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	- -	2.260	- -	- -	57.40	- -
B	1.610	1.640	- -	40.89	41.66	- -
C	1.855	1.985	- -	47.12	50.42	- -
D	1.470	1.560	- -	37.34	39.62	- -
E	0.710	0.790	- -	18.03	20.07	- -
F	- -	1.250	- -	- -	31.75	- -
G	0.150	- -	- -	3.81	- -	- -
H	BASE: E11-81 (JEDEC DESIGNATION)					
J	CAP: C1-1 (JEDEC DESIGNATION)					
L	0.080	- -	- -	2.03	- -	- -
M	1.416	1.436	- -	35.97	36.47	- -
N	0.280	0.320	- -	7.11	8.13	- -



NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*)CONTACT SURFACE.
3. PIN PITCH DIA. TO BE CONCENTRIC TO B WITHIN .040 DIA.
4. DIM. M TO BE CONCENTRIC TO B & PIN PITCH DIA. WITHIN .030 DIA.

8122W

Eimac®

EITEL-McCULLOUGH, INC.

8165
4-65A

RADIAL-BEAM POWER TETRODE

●

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 8165/4-65A is a small radial-beam tetrode with a maximum plate-dissipation rating of 65 watts. In most applications, no forced air is required, normal radiation and convection cooling being adequate. An instant-heating, thoriated tungsten filament is employed, allowing all electrode voltages to be applied simultaneously and permitting the conservation of power during standby periods. The 8165/4-65A is, therefore, a good choice for many mobile applications.

Short, heavy leads and low interelectrode capacities assure stable, efficient operation at high frequencies and permit its use at maximum ratings through 150 megacycles. The 8165/4-65A is equally useful in audio-amplifier or modulator service.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		6.0		volts
Current	3.2		3.8	amperes
Grid-Screen Amplification Factor	5		7	
Direct Interelectrode Capacitances:				
Grid-Plate			0.12	uuf
Input	6.0		8.3	uuf
Output	1.9		2.6	uuf
Frequency for Maximum Ratings			150	mc

MECHANICAL

Base	5-pin—National HX-29 or Johnson 122-101
Maximum Seal Temperature	200° C
Maximum Envelope Temperature	225° C
Recommended Socket Operating Position	Vertical, base down or up
Cooling	Convection and radiation
Recommended Heat Dissipating Connector	Eimac HR-6
Maximum Over-all Dimensions	
Length	4.19 inches
Diameter	2.38 inches
Net Weight	3 ounces
Shipping Weight (Approximate)	1.5 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS (Key-down conditions)

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	150 MAX. MA
PLATE DISSIPATION	65 MAX. WATTS
SCREEN DISSIPATION	10 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 megacycles)

D-C Plate Voltage	1500	2000	2500	3000 volts
D-C Screen Voltage	250	250	250	250 volts
D-C Grid Voltage	—105	—105	—105	—105 volts
D-C Plate Current	150	137	124	112 ma
D-C Screen Current*	39	32	26	22 ma
D-C Grid Current*	19	15	13	9 ma
Peak R-F Grid Voltage*	205	195	185	175 volts
Driving Power*	3.9	2.9	2.4	1.6 watts
Plate Input Power	225	275	310	335 watts
Plate Output Power	160	210	245	270 watts

*Approximate values

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony

MAXIMUM RATINGS (Carrier conditions)

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	120 MAX. MA
PLATE DISSIPATION	45 MAX. WATTS
SCREEN DISSIPATION	10 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 megacycles)

D-C Plate Voltage	1000	1500	2000	2500 volts
D-C Screen Voltage	250	250	250	250 volts
D-C Grid Voltage	—150	—150	—150	—150 volts
D-C Plate Current	120	120	113	102 ma
D-C Screen Current*	40	40	37	26 ma
D-C Grid Current*	20	20	18	13 ma
Peak R-F Voltage*	255	255	250	235 volts
Driving Power*	5.1	5.1	4.8	3.1 watts
Plate Input Power	120	180	226	255 watts
Plate Output Power	85	140	182	210 watts

*Approximate values

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AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C PLATE CURRENT	150 MAX. MA
PLATE DISSIPATION	65 MAX. WATTS
SCREEN DISSIPATION	10 MAX. WATTS

RADIO-FREQUENCY SSB POWER AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C PLATE CURRENT	150 MAX. MA
PLATE DISSSIPATION	65 MAX. WATTS
SCREEN DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION

Class-AB_1 (Sinusoidal wave, two tubes except where noted)

D-C Plate Voltage	1500	2000	2500	3000 volts
D-C Screen Voltage	500	500	400	400 volts
D-C Grid Voltage[1]	—90	—105	—85	—90 volts
Zero-Signal D-C Plate Current	60	40	30	30 ma
Max.-Signal D-C Plate Current	166	150	132	120 ma
Max.-Signal D-C Screen Current*	10	6	6	6 ma
Peak A-F Grid Voltage (per tube)*	70	80	77	77 volts
Effective Plate-to-Plate Load	13,300	24,000	37,500	50,000 ohms
Max.-Signal Plate Input Power	250	300	330	360 watts
Max.-Signal Plate Output Power	120	170	200	240 watts

[1]Adjust to obtain listed zero-signal d-c plate current.
*Approximate values.

TYPICAL OPERATION

Class-AB1 (Frequencies to 150 megacycles)

D-C Plate Voltage	1500	2000	2500	3000 volts
D-C Screen Voltage	500	500	400	400 volts
D-C Grid Voltage[1]	—90	—105	—85	—90 volts
Zero-Signal D-C Plate Current	30	20	15	15 ma
Max.-Signal D-C Plate Current	83	75	66	60 ma
Max.-Signal D-C Screen Current*	5	3	3	3 ma
Peak R-F Grid Voltage*	70	80	77	77 volts
Max.-Signal Plate Input Power	125	150	165	180 watts
Max.-Signal Plate Output Power	60	85	100	120 watts

[1]Adjust to obtain listed zero-signal d-c plate current.
*Approximate Values.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

In class-C operation, adjustment of the r-f grid drive to obtain listed plate current at the listed grid bias, screen voltage, and plate voltage is assumed. Resultant screen and grid currents will vary from tube to tube, but little change in output power will be noted.

In class-AB_1 linear operation, screen current will also vary from tube to tube but is a useful indicator of relative linearity. In general, less screen current means better linearity, providing other conditions are held constant. The same degree of linearity will be obtained from different tubes if loading and drive are adjusted to give the same plate and screen current, although output power may vary from tube to tube.

APPLICATION

MECHANICAL

Mounting—The 4-65A must be operated vertically, base up or base down. The socket must provide clearance for the glass tip-off which extends from the center of the base. A flexible connecting strap should be provided between the plate terminal and the external plate circuit, and the Eimac HR-6 connector (or equivalent) used on the tube plate lead. The socket must not apply lateral pressure against the base pins. The tube must be protected from severe vibration and shock.

Adequate ventilation must be provided so that the seals and/or envelope under operating conditions do not exceed their rated maximum temperatures. For operation above 50 Mc. the plate voltage should be reduced, or special attention should be given to seal cooling.

When the ambient temperature does not exceed 30° C it will not ordinarily be necessary to provide forced-air cooling of the envelope or plate seal at frequencies below 50 Mc. provided that a heat-radiating plate connector is used and the tube is so located that normal circulation of air past the envelope is not impeded.

ELECTRICAL

Filament Voltage—The filament voltage, as measured at the filament pins, should be 6.0 volts. For long life, excursions from this value should not exceed ± 5 percent.

Bias Voltage—D-C bias voltage for the 4-65A should not exceed —500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Screen Voltage—The d-c screen voltage for the 4-65A should not exceed 400 volts except in the case of class-AB audio operation and Single-Side-Band r-f amplifier operation where it should not exceed 600 volts.

Screen Dissipation—The power dissipated by the screen of the 4-65A must not exceed 10 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load is removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 10 watts in the event of circuit failure.

Plate Voltage—The plate-supply voltage for the 4-65A should not exceed 3000 volts. Above 50 Mc. it is advisable to use a lower plate voltage than the maximum, since the seal heating due to r-f charging currents in the screen leads increases with plate voltage and frequency. See instructions on seal cooling under "Mechanical" and "Shielding."

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-65A should not be allowed to exceed 65 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 45 watts.

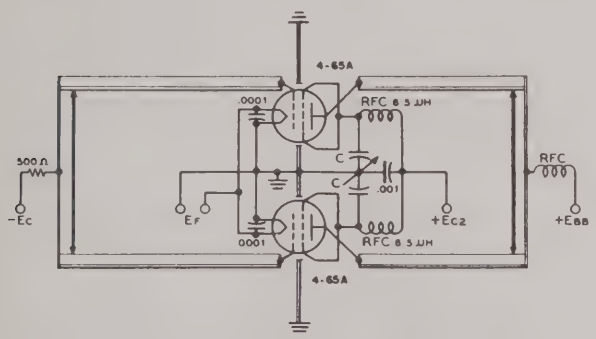
Plate dissipation in excess of the maximum rating is permissable for short periods of time, such as during tuning procedures.

OPERATION

Class-C FM or Telegraphy—The 4-65A may be operated as a class-C FM or telegraphy amplifier without

neutralization up to 110 Mc. if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. In single-ended circuits, plate, grid, filament, and screen by-pass capacitors should be returned through the shortest possible leads and short, heavy leads should be used to inter-connect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier in order to minimize grid-plate coupling between these leads external to the amplifier.

Where shielding is adequate, the feedback at frequencies above 110 Mc. is due principally to screen-lead-inductance effects and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid cricuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately ¾" square and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope. An alternate neutralization scheme for use above 110 Mc. is illustrated in the diagram shown below. In this circuit, feedback is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together as shown on the diagram, by the shortest possible lead, and the lead from the mid point of this screen strap to the capacitor, C, and from the capacitor to ground should be made as short as possible.

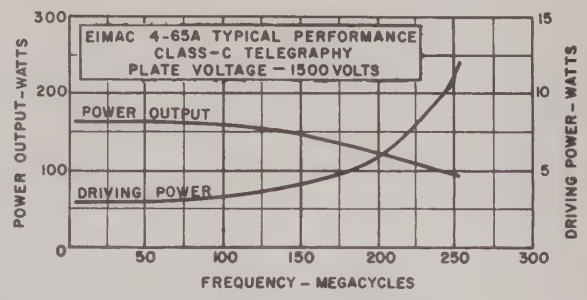


Screen-tuning neutralization circuit for use above 100 Mc. C is a small split-stator capacitor.

$$C(\mu\mu fd) = \frac{640{,}000}{f^2\ (Mc.)}\text{, approx.}$$

Typical driving power and output power versus frequency are shown below. The output power shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output should exceed the driving power requirements by a sufficient margin to allow for coupling-circuit losses. The use of silver-plated linear tank-circuit elements is recommended at frequencies above 75 Mc.

Class-C AM Telephony—The r-f circuit considerations discussed above under class-C FM or telegraphy also apply to amplitude-modulated operation of the 4-65A. When the 4-65A is used as a class-C high-level-modulated amplifier, both the plate and screen



should be modulated. Modulation voltage for the screen may be obtained by supplying the screen voltage through a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead, or from a separate winding on the modulation transformer. When screen modulation is obtained by either the series-resistor or the audio-reactor methods, the audio-frequency variations in screen current, which result from the variations in plate voltage as the plate is modulated, automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two to three times the operating d-c screen current. To prevent phase-shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate r-f by-passing.

For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

Class-AB$_1$ and Class-AB$_2$ Audio—Two 4-65As may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB$_1$ audio operation are given in the tabulated data.

Screen voltage should be obtained from a source having good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage-regulator tubes in a standard circuit should provide adequate regulation.

Grid-bias voltage for class-AB$_2$ service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB$_1$ conditions the effective grid-circuit resistance should not exceed 250,000 ohms.

In some cases the maximum-signal plate dissipation shown under "Typical Operation" is less than the maximum rated plate dissipation of 4-65A. In these cases, with sine-wave modulation, the plate dissipation reaches a maximum value, equal to the maximum rating, at a point somewhat below maximum-signal conditions.

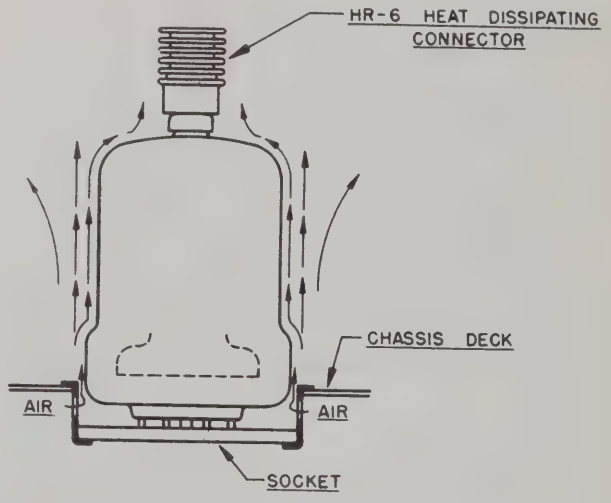
The output-power figures given in the tabulated data refer to the total output power from the amplifier tubes. The useful output power will be from 5 to 15 percent less than the figure shown, due to losses in the output transformer.

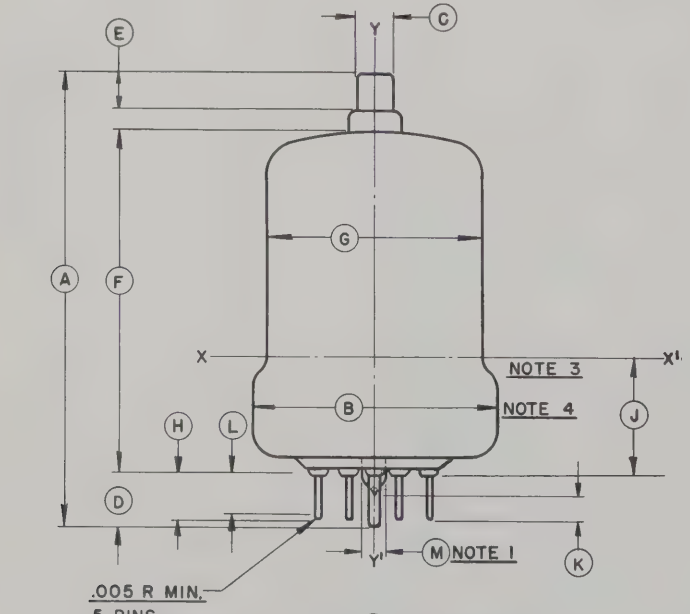
Shielding—The internal feedback of the tetrode has been substantially eliminated and in order to fully utilize this advantage, it is essential that the design of the equipment completely eliminate any feedback external to the tube. This means complete shielding of the output cricuit from the input circuit and earlier stages, proper reduction to low values of the inductance of the screen lead to the r-f ground, and elimination of r-f feedback in any common power-supply leads.

Complete shielding is easily achieved by mounting the socket of the tube flush with the deck of the chassis as shown in the sketch shown at the right.

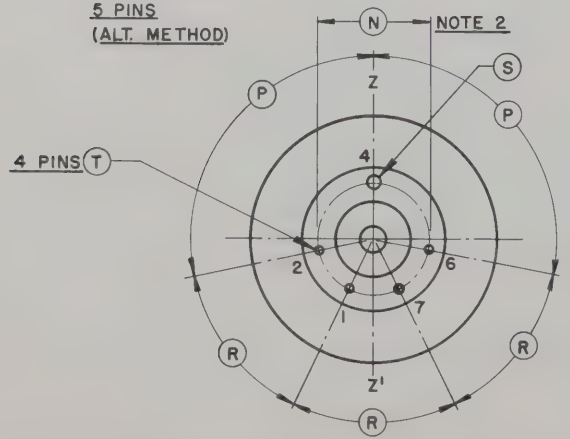
The holes in the socket permit the flow of convection air currents from below the chassis up past the seals in the base of the tube. This flow of air is essential to cool the tube and in cases where the complete under-part of the chassis is enclosed for electrical shielding, screened holes or louvers should be provided to permit air circulation. Note that shielding is completed by aligning the internal screen shield with the chassis deck and by proper r-f by-passing of the screen leads to r-f ground. The plate and output circuits should be kept above deck and the input circuit and circuits of earlier stages should be kept below deck or completely shielded.

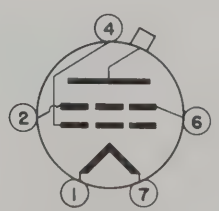
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations. Copies of characteristic curves, either constant-grid-voltage or constant-current, for various screen potentials may be obtained from this department on request.



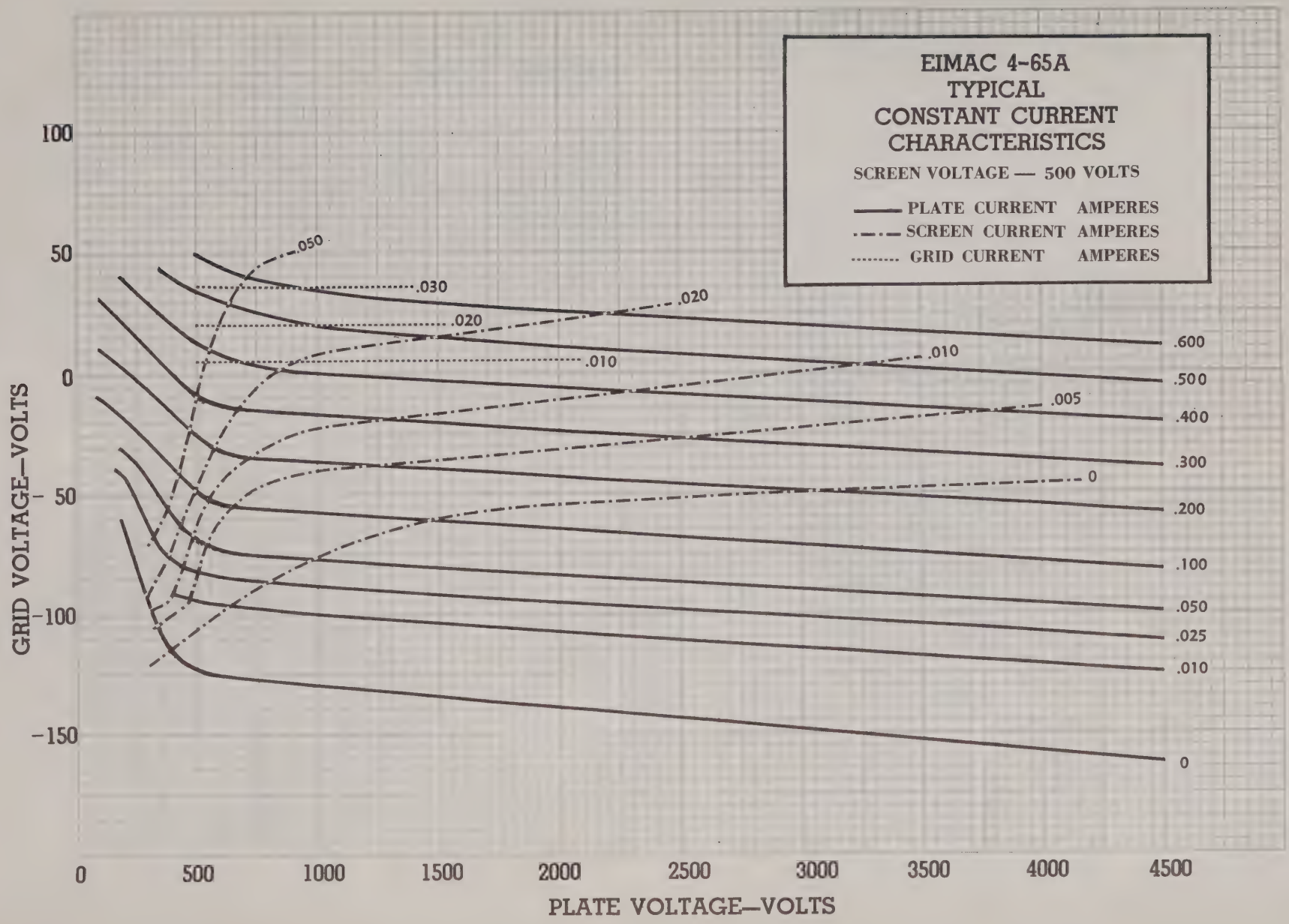


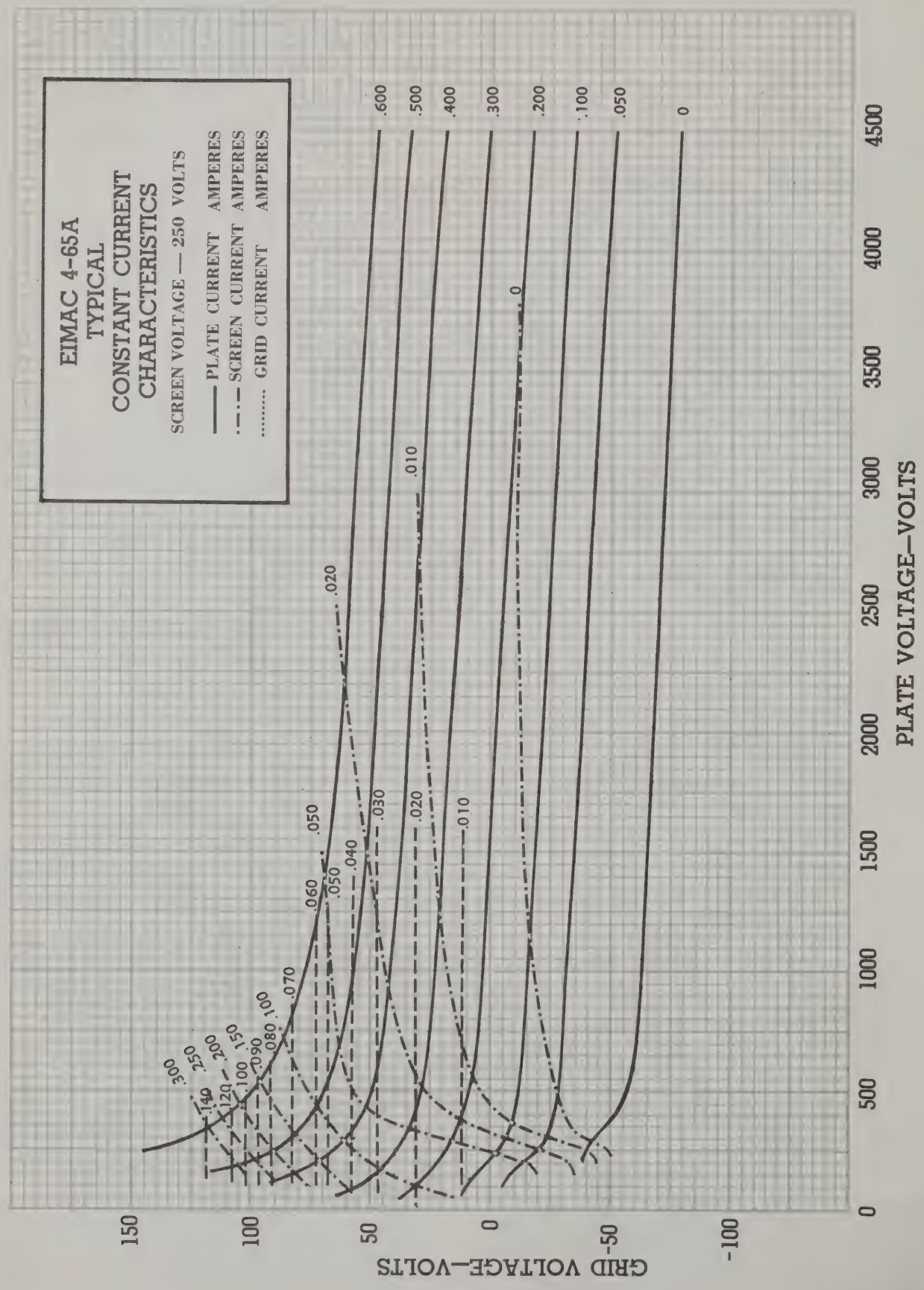
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		4	4 3/16
B			2 3/8
C		.350	.365
D		7/16	9/16
E		21/64	
F		2 15/16	3 5/16
G			2 1/8
H		3/8	1/2
J		.844	1.219
K		.000	
L		5/16	
M			3/8
N	1.000		
P	102°		
R	52°		
S		.122 DIA.	.128 DIA.
T		.055 DIA.	.061 DIA.





ALL DIMENSIONS IN INCHES.


EIMAC 4-65A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT AMPERES
SCREEN CURRENT AMPERES
GRID CURRENT AMPERES
100
50
0
−50
−100
−150
GRID VOLTAGE—VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
PLATE VOLTAGE—VOLTS
.050
.030
.020
.010
.020
.010
.005
0
.600
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.400
.300
.200
.100
.050
.025
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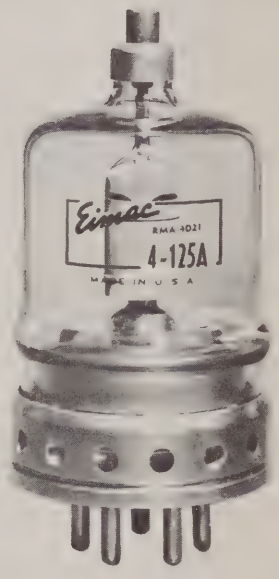
4-125A

(4D21)
RADIAL-BEAM
POWER TETRODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

EITEL-McCULLOUGH, INC.
SAN MATEO, CALIFORNIA



The Eimac 4-125A is a radial-beam power tetrode intended for use as an amplifier, oscillator, or modulator. It has a maximum plate-dissipation rating of 125 watts and a maximum plate-voltage rating of 3000 volts at frequencies up to 120 Mc.

The low grid-plate capacitance of this tetrode together with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

Cooling is by radiation from the plate and by air circulation through the base and around the envelope.

The 4-125A in class-C r-f service will deliver up to 375 watts plate power output with 2.5 watts driving power. Two 4-125A's in class-B modulator service will deliver up to 400 watts maximum-signal power output with 1.2 watts nominal driving power.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	6.5 amperes
Grid-Screen Amplification Factor (Average)	5.9
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.05 $\mu\mu$fd
Input	10.8 $\mu\mu$fd
Output	3.1 $\mu\mu$fd
Transconductance (I_b=50 ma., E_b=2500V., E_{c2}=400V.)	2450 μmhos
Highest Frequency for Maximum Ratings	120 Mc

MECHANICAL

Base	5-pin metal shell
Basing	See outline drawing
Socket	E. F. Johnson Co. socket No. 122-275, National Co. No. HX-100, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	5.69 inches
Diameter	2.81 inches
Net Weight	6.5 ounces
Shipping Weight	1.5 pounds

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

(Effective 6-1-60) Copyright, 1954 by Eitel-McCullough, Inc.

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	225 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 120 Mc.)

D-C Plate Voltage	2000	2500	3000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage	—100	—150	—150 volts
D-C Plate Current	200	200	167 ma
D-C Screen Current	50	40	30 ma
D-C Grid Current	12	12	9 ma
Screen Dissipation	18	14	10.5 watts
Grid Dissipation	1.6	2	1.2 watts
Peak R-F Grid Input Voltage (approx.)	230	320	280 volts
Driving Power (approx.)[3]	2.8	3.8	2.5 watts
Plate Power Input	400	500	500 watts
Plate Dissipation	125	125	125 watts
Plate Power Output	275	375	375 watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	600	600	600	volts
D-C Grid Voltage[2]	—90	—94	—96	volts
Zero-Signal D-C Plate Current	60	50	50	ma
Max-Signal D-C Plate Current	222	240	232	ma
Zero-Signal D-C Screen Current	—1.0	—0.5	—0.3	ma
Max-Signal D-C Screen Current	17	6.4	8.5	ma
Effective Load, Plate-to-Plate	10,200	13,400	20,300	ohms
Peak, A-F Grid Input Voltage (per tube)	90	94	96	volts
Driving Power	0	0	0	watt
Max-Signal Plate Dissipation (per tube)	87.5	125	125	watts
Max-Signal Plate Power Output	158	230	330	watts
Total Harmonic Distortion	5	2	2.6	per ct.

HIGH-LEVEL MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony
(Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	85 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 120 Mc.)

D-C Plate Voltage	2000	2500	volts
D-C Screen Voltage	350	350	volts
D-C Grid Voltage	—220	—210	volts
D-C Plate Current	150	152	ma
D-C Screen Current	33	30	ma
D-C Grid Current	10	9	ma
Screen Dissipation	11.5	10.5	watts
Grid Dissipation	1.6	1.4	watts
Peak A-F Screen Voltage, 100% Modulation	210	210	volts
Peak R-F Grid Input Voltage (approx.)	375	360	volts
Driving Power (approx.)[3]	3.8	3.3	watts
Plate Power Input	300	380	watts
Plate Dissipation	75	80	watts
Plate Power Output	225	300	watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_2

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage	—41	—45	—43	volts
Zero-Signal D-C Plate Current	87	72	93	ma
Max-Signal D-C Plate Current	400	300	260	ma
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	34	5	6	ma
Effective Load, Plate-to-Plate	7200	13,600	22,200	ohms
Peak A-F Grid Input Voltage (per tube)	141	105	89	volts
Max-Signal Avg. Driving Power (approx.)	2.5	1.4	1	watts
Max-Signal Peak Driving Power	5.2	3.1	2.4	watts
Max-Signal Plate Dissipation (per tube)	125	125	122	watts
Max-Signal Plate Power Output	350	350	400	watts
Total Harmonic Distortion	2.5	1	2.2	per ct.

[1] Above 120 Mc. the maximum plate voltage rating depends upon frequency. See page 4.

[2] The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

[3] Driving power increases above 70 Mc. See page 4.

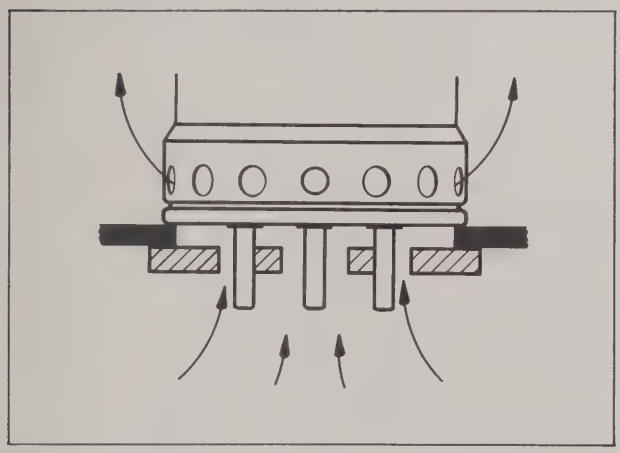
IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting—The 4-125A must be mounted vertically, base down or base up. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The tube should be mounted above the chassis deck to allow free circulation of air in the manner shown in the mounting diagram below. The above requirements are met by the E. F. Johnson Co. socket No. 122-275, the National Co. socket No. HX-100, or a similar socket.

A flexible connecting strap should be provided between the HR-6 Heat Dissipating Plate Connector on the plate terminal and the external circuit. The tube must be protected from severe vibration and shock.



4-125A mounting providing base cooling, shielding and isolation of output and input compartments.

Cooling—Adequate cooling must be provided for the seals and envelope of the 4-125A. In continuous-service applications, the temperature of the plate seal, as measured on the top of the plate cap, should not exceed 170° C. A relatively slow movement of air past the tube is sufficient to prevent seal temperatures in excess of maximum at frequencies below 30 Mc. At frequencies above 30 Mc., radio frequency losses in the leads and envelope contribute to seal and envelope heating, and special attention should be given to cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 Mc., however.

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten-minute period, plate seal temperatures as high as 220° C. are permissible. When the ambient temperature does not exceed 30° C. it will not ordinarily be necessary to provide forced cooling to hold the temperature below this maximum at frequencies below 30 Mc., provided that a heat-dissipating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

Provision must be made for circulation of air through the base of the tube. Where shielding or socket design makes it impossible to allow free circulation of air through the base, it will be necessary to apply forced-air cooling to the stem structure. An air flow of two cubic feet per minute through the base will be sufficient for stem cooling.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage—D-c bias voltage for the 4-125A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Screen Voltage—The d-c screen voltage for the 4-125A should not exceed 400 volts, except for class-AB_1 audio operation.

Plate Voltage—The plate-supply voltage for the 4-125A should not exceed 3000 volts for frequencies below 120 Mc. The maximum permissible plate voltage is less than 3000 volts above 120 Mc., as shown by the graph on page 5.

Grid Dissipation—Grid dissipation for the 4-125A should not be allowed to exceed five watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.

Screen Dissipation—The power dissipated by the screen of the 4-125A must not exceed 20 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 20 watts in the event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-125A should not be allowed to exceed 125 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 85 watts. The plate dissipation will rise to 125 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

OPERATION

Class-C Telegraphy or FM Telephony—The 4-125A may be operated as a class-C telegraph or FM telephone amplifier without neutralization up to about 30 Mc. if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. A grounded metallic plate on which the socket may be mounted as shown in the mounting diagram on page three provides an effective isolating shield between grid and plate circuits. In single-ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier, to prevent grid-plate coupling between these leads external to the amplifier.

Where shielding is adequate, the feed-back at frequencies above 100 Mc. is due principally to screen-lead-inductance effects, and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately ¾-inch square connected to the grid terminal and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope, but care must be taken to prevent the neutralizing plate from touching the envelope. An alternative neutralization scheme is illustrated in the diagram below. In this circuit feed-back is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together, as shown on the diagram, by the shortest posible lead, and the leads from the screen terminal to the capacitor, C, and from the capacitor to ground should be made as short as possible. All connections to the screen terminals should be made to the center of the strap between the terminals, in order to equalize the current in the two screen leads and prevent overheating one of them. The value for C given under the diagram presupposes the use of the shortest possible leads.

At frequencies below 100 Mc. ordinary neutralization systems may be used. With reasonably effective shielding, however, neutralization should not be required below about 30 Mc.

The driving power and power output under typical operating conditions, with maximum output and plate voltage, are shown on page 5. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirement by a sufficient margin to allow for coupling-circuit losses. These losses will not ordinarily amount to more than 30 or 40 per cent of the driving power, except at frequencies above 150 Mc. The use of silver-plated linear tank-circuit elements is recommended at frequencies above 100 Mc.

Conventional capacitance-shortened quarter-wave linear grid tank circuits having a calculated Z_0 of 160 ohms or less may be used with the 4-125A up to 175 Mc. Above 175 Mc. linear grid tank circuits employing a "capacitor"-type shortening bar, as illustrated in the diagram below, may be used. The capacitor, C_1, may consist of two silver-plated brass plates one inch square with a piece of .010 inch mica or polystyrene as insulation.

Class-C AM Telephony—The r-f circuit considerations discussed above under Class-C Telegraphy or FM Telephony also apply to amplitude-modulated operation of the 4-125A. When the 4-125A is used as a class-C high-level-modulated amplifier, modulation should be applied to both plate and screen. Modulation voltage for the screen may be obtained from a separate winding on the modulation transformer, by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead. When screen modulation is obtained by either the series-resistor or the audio-reactor method, the audio-frequency variations in screen current which result from variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two or three times the operating d-c screen current. To prevent phase shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate r-f by-passing. Where screen voltage is obtained from a separate winding on the modulation transformer, the screen winding should be designed to deliver the peak screen modulation voltage given in the typical operating data on page 2.

For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

Class-AB_1 and Class-AB_2 Audio—Two 4-125A's may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB_1 and class-AB_2 audio operation are given in the tabulated data.

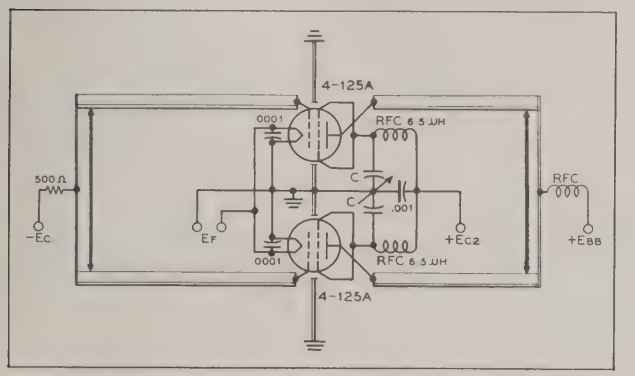
When type 4-125A tubes are used as class-AB_1 or class-AB_2 audio amplifiers at 1500 plate volts, under the conditions given under "Typical Operation", the screen voltage must be obtained from a source having reasonably good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit will provide adequate regulation. The variation in screen current at plate voltages of 2000 and above is low enough so that any screen power supply having a normal order

of regulation will serve. The driver plate .supply makes a convenient source of screen voltage under these conditions.

Grid bias voltage for class-AB_2 service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB_1 conditions the effective grid-circuit resistance for each tube should not exceed 250,000 ohms.

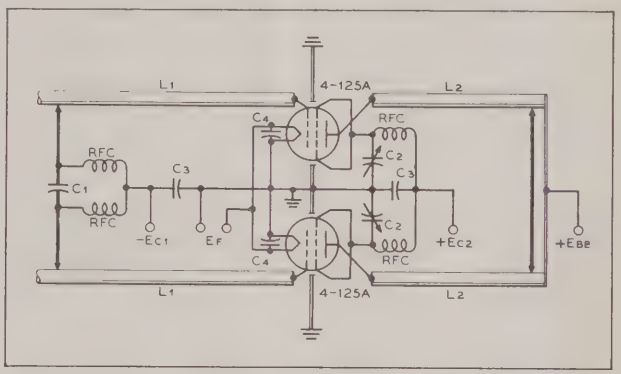
The peak driving power figures given in the class-AB_2 tabulated data are included to make possible an accurate determination of the required driver output power. The driving amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.



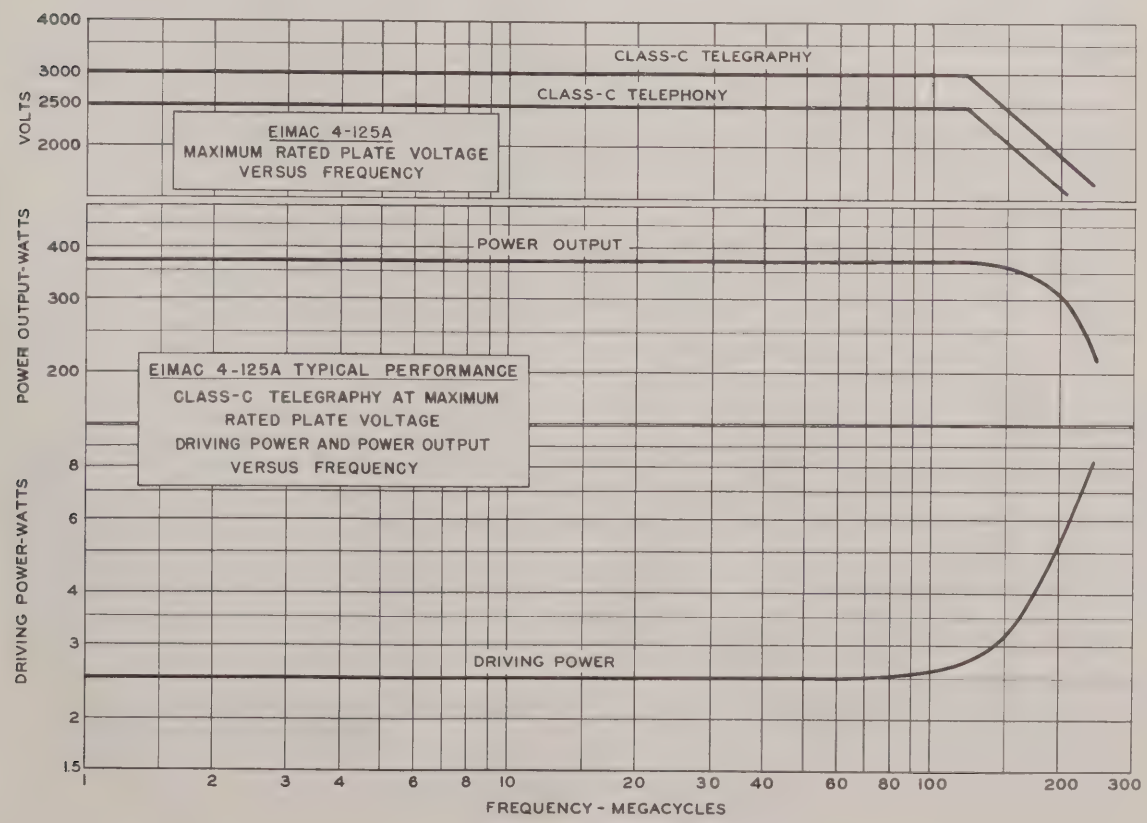
Screen-tuning neutralization circuit for use above 100 Mc.
C is a small split-stator capacitor.

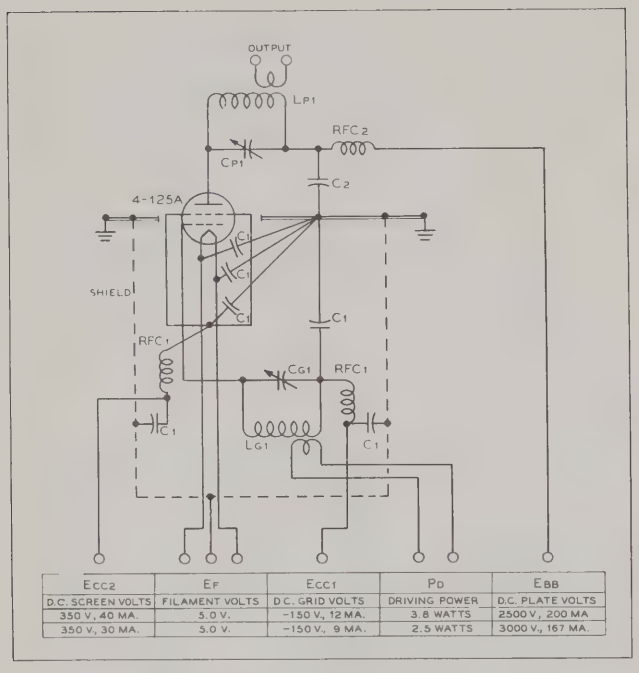
$$C(\mu\mu fd) = \frac{640{,}000}{f^2\ (Mc.)}\ ,\ approx.$$



Typical circuit arrangement useful for frequencies above 175 Mc.

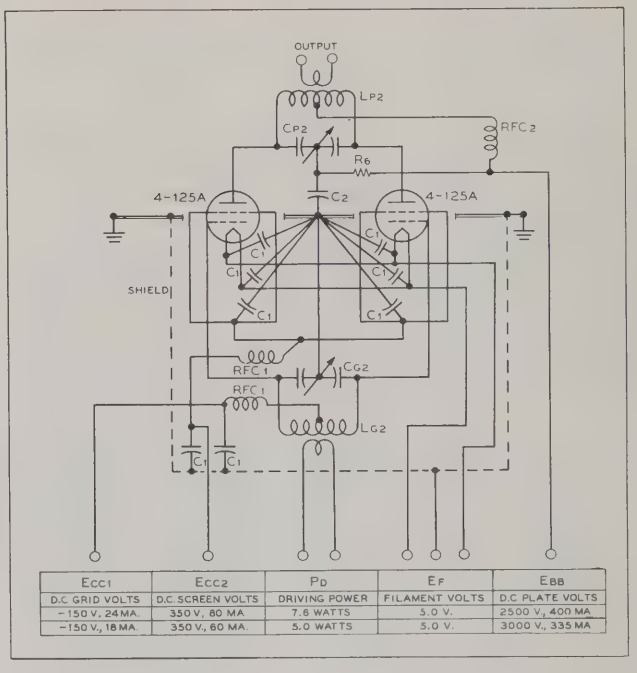
C_1—See above.
C_2—Neutralizing capacitor.
C_3—.001 μfd.
C_4—100 $\mu\mu$fd.
L_1—3/8" dia. copper spaced 1" center-to-center, 6" long.
L_2—7/8" dia. brass, silver plated, spaced 1 1/2" center-to-center, 14" long.





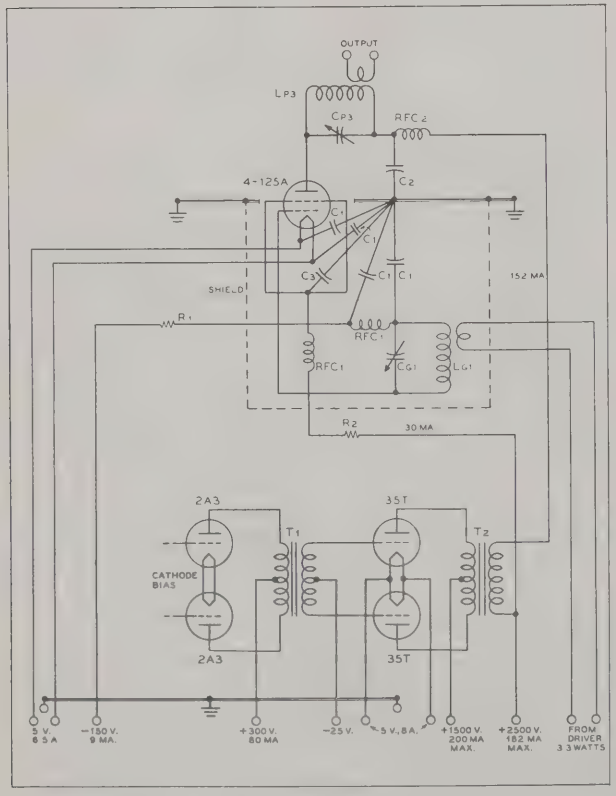
E_{CC2}	E_F	E_{CC1}	P_D	E_{BB}
D.C. SCREEN VOLTS	FILAMENT VOLTS	D.C. GRID VOLTS	DRIVING POWER	D.C. PLATE VOLTS
350 V, 40 MA.	5.0 V.	−150 V., 12 MA.	3.8 WATTS	2500 V., 200 MA
350 V., 30 MA.	5.0 V.	−150 V., 9 MA.	2.5 WATTS	3000 V., 167 MA.

Typical radio-frequency power amplifier circuit, Class-C telegraphy, 500 watts input.

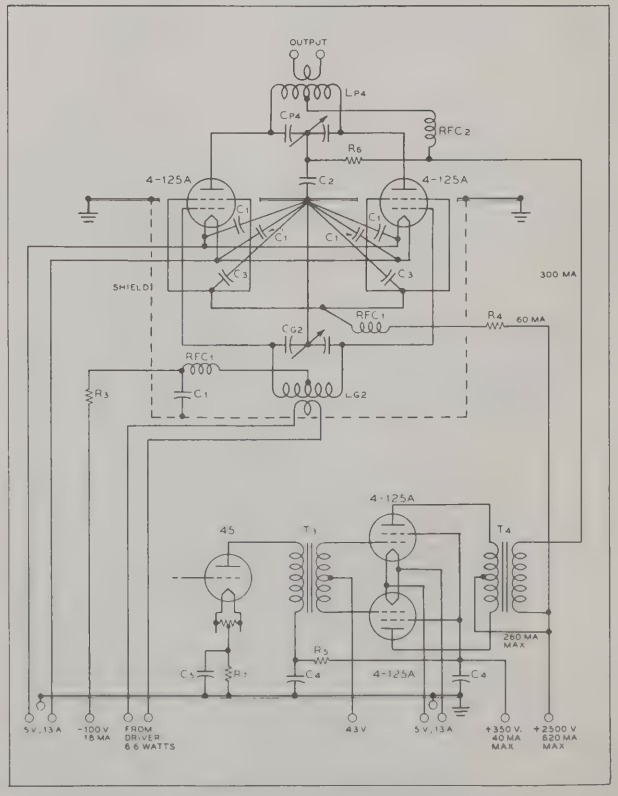


E_{CC1}	E_{CC2}	P_D	E_F	E_{BB}
D.C GRID VOLTS	D.C. SCREEN VOLTS	DRIVING POWER	FILAMENT VOLTS	D.C PLATE VOLTS
−150 V., 24 MA.	350 V., 80 MA	7.6 WATTS	5.0 V.	2500 V., 400 MA
−150 V., 18 MA.	350 V., 60 MA.	5.0 WATTS	5.0 V.	3000 V., 335 MA

Typical radio-frequency power amplifier circuit, Class-C telegraphy, 1000 watts input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 380 watts plate input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 750 watts plate input.

See opposite page for list of components.

COMPONENTS FOR TYPICAL CIRCUITS

(Diagrams, Page 6)

L_{p1} - C_{p1} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p2} - C_{p2} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p3} - C_{p3} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{p4} - C_{p4} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{g1} - C_{g1} — Tuned circuit appropriate for operating frequency.

L_{g2} - C_{g2} — Tuned circuit appropriate for operating freqency.

C_1 — .002-ufd., 500-v. mica

C_2 — .002-ufd., 5000-v. mica

C_3 — .001-ufd., 2500-v. mica

C_4 — 16-ufd., 450-v. electrolytic

C_5 — 10-ufd., 25-v. electrolytic

R_1 — 7000 ohms, 5 watts

R_2 — 70,000 ohms, 100 watts

R_3 — 3500 ohms, 5 watts

R_4 — 35,000 ohms, 200 watts

R_5 — 560 ohms, 1 watt

R_6 — 25,000 ohms, 2 watts

R_7 — 1500 ohms, 5 watts

RFC_1 — 2.5-mhy., 125-ma. r-f choke

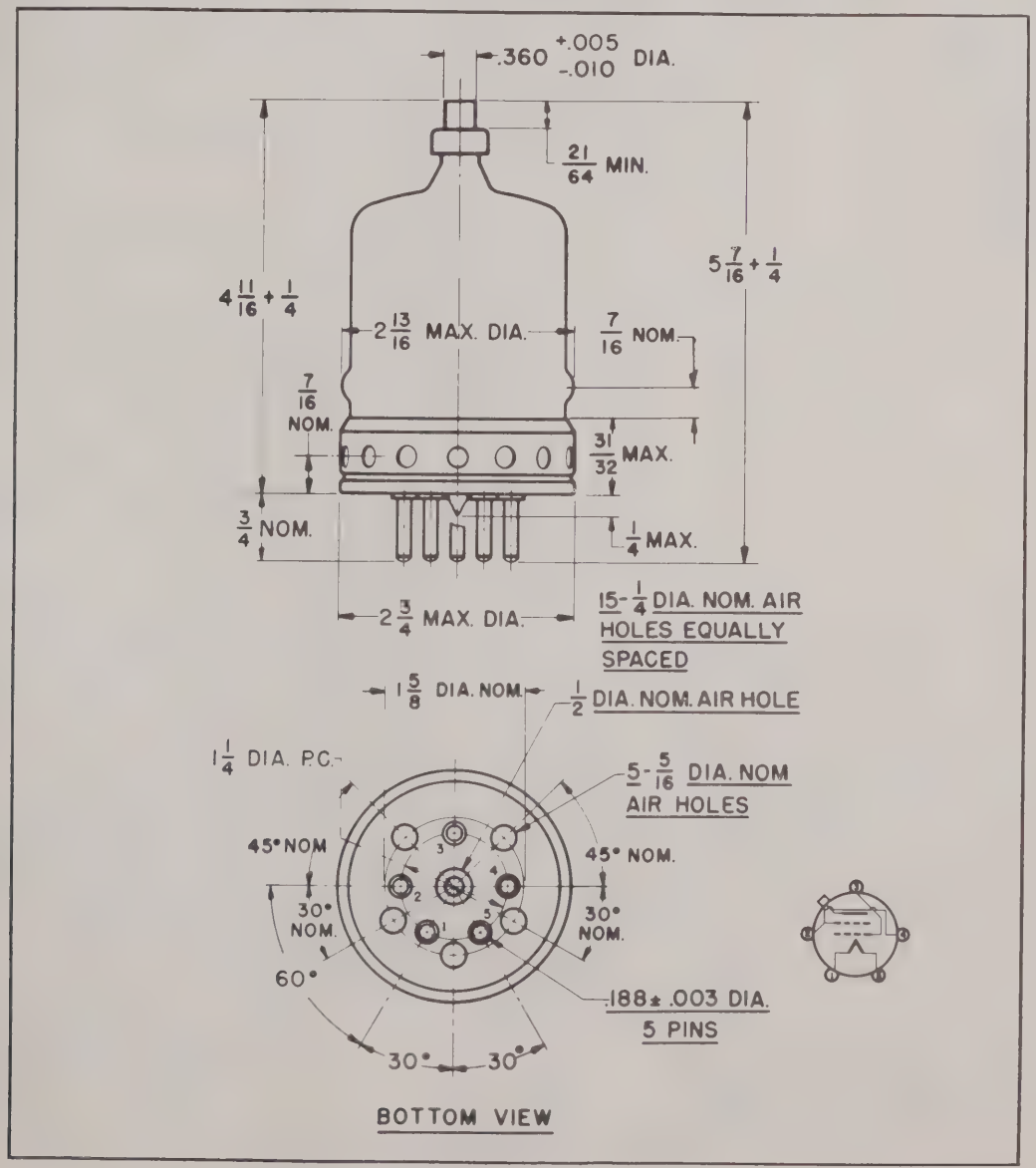
RFC_2 — 1-mhy., 500-ma. r-f choke

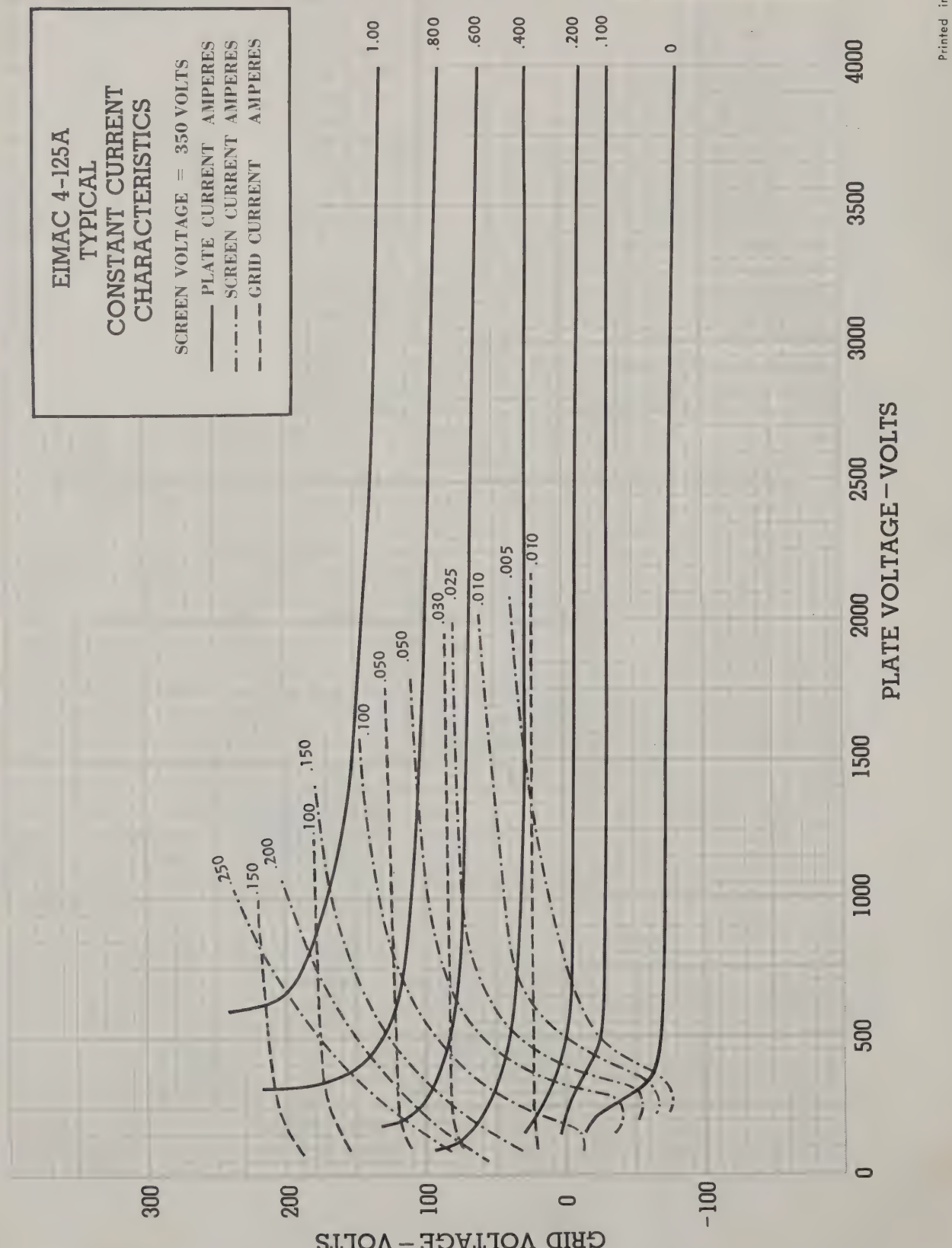
T_1 — 10-watt driver transformer; ratio pri. to ½ sec. approx. 2:1.

T_2 — 200-watt modulation transformer; ratio pri. to sec. approx. 1:1; pri. impedance = 16,200 ohms, sec. impedance = 16,500 ohms.

T_3 — 5-watt driver transformer; ratio pri. to ½ sec. approx. 1.1:1.

T_4 — 400-watt modulation transformer; ratio pri. to sec. approx. 2.7:1; pri. impedance = 22,200 ohms, sec. impedance = 8300 ohms.





Printed in U.S.A. 814

EIMAC
Division of Varian

8438
4-400A

RADIAL BEAM
POWER TETRODE

The EIMAC 8438/4-400A is a compact, ruggedly constructed power tetrode having a maximum plate dissipation rating of 400 watts. It is intended for use as an amplifier, oscillator or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

The 8438/4-400A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an EIMAC SK-400 Series Air System Socket and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.[3]



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	14.5 A
Transconductance (Average):	
I_b = 100 mA, E_{c2} = 500 volts	4000 μmhos
Amplification Factor (Average):	
Grid to Screen	5.1
Direct Interelectrode Capacitances (grounded filament)[2]	
Input	12.5 pF
Output	4.7 pF
Feedback	0.12 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. In Shielded Fixture.
3. Guarantee applies only when the 4-400A is used as specified with adequate air in the SK-400 or SK-410 Air-System Socket and associated chimney or equivalent.

MECHANICAL

Maximum Overall Dimensions:	
Length	6.375 in; 161.93 mm
Diameter	3.563 in; 90.50 mm

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Net Weight	9.0 oz; 255 gm
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Plate Seal	225°C
Base Seals	200°C
Cooling	Radiation and forced air
Base	Special 5-pin
Recommended Socket	EIMAC SK-400 Series
Recommended Chimney	EIMAC SK-406
Recommended Heat-Dissipating Connectors:	
Plate	HR-6

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN
Class AB_1

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	800	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Frequencies to 75 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	3000	Vdc
Screen Voltage	750	Vdc
Grid Voltage[1]	-130	Vdc
Zero-Signal Plate Current	80	mAdc
Single Tone Plate Current	290	mAdc
Single-Tone Screen Current[2]	13	mAdc
Useful Output Power	470	W
Resonant Load Impedance	5000	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class C Telegraphy or FM Telephony (Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Frequencies to 75 MHz)

Plate Voltage	2500	3000	4000	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-200	-220	-220	Vdc
Plate Current	350	350	350	mAdc
Screen Current[1]	46	46	40	mAdc
Screen Dissipation	23	23	20	W
Grid Current[1]	18	19	18	mAdc
Peak rf Grid Voltage[1]	300	320	320	v
Grid Dissipation	1.8	1.9	1.8	W
Calculated Driving Power[2]	5.4	6.1	5.8	W
Plate Input Power	875	1050	1400	W
Plate Dissipation	235	250	300	W
Plate Output Power	640	800	1100	W

1. Approximate value.
2. Driving Power increases with frequency. At 75 MHz driving power is approximately 12 watts.

TYPICAL OPERATION (110 MHz, two tubes)

Plate Voltage	3500	4000	Vdc
Screen Voltage	500	500	Vdc
Grid Voltage	-170	-170	Vdc
Plate Current	500	540	mAdc
Screen Current	34	31	mAdc
Grid Current	20	20	mAdc
Driving Power[1]	20	20	W
Plate Output Power[1]	1300	1600	W
Useful Output Power	1160	1440	W

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	3200	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	270	WATTS
SCREEN DISSIPATION[2]	35	WATTS
GRID DISSIPATION[2]	10	WATTS

1. Corresponds to 400 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 75 MHz)

Plate Voltage	2000	2500	3000	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-220	-220	-220	Vdc
Plate Current	275	275	275	mAdc
Screen Current[1]	30	28	26	mAdc
Screen Dissipation	15	14	13	W
Grid Current[1]	12	12	12	mAdc
Grid Dissipation	1.1	1.1	1.1	W
Peak af Screen Voltage[1] (100% modulation)	350	350	350	v
Peak rf Grid Voltage[1]	290	290	290	v
Calculated Driving Power[1]	3.5	3.5	3.5	W
Plate Input Power	550	688	825	W
Plate Dissipation	170	178	195	W
Plate Output Power	380	510	630	W

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	800	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Two Tubes) Class AB_1

Plate Voltage	2500	3000	3500	4000	Vdc
Screen Voltage	750	750	750	750	Vdc
Grid Voltage[1/4]	-130	-137	-145	-150	Vdc
Zero-Signal Plate Current	190	160	140	120	mAdc
Max. Signal Plate Current	635	635	610	585	mAdc
Zero-Signal Screen Current	0	0	0	0	mAdc
Max. Signal Screen Current[1]	28	26	32	40	mAdc
Peak af Grid Voltage[2]	130	137	145	150	v
Peak Driving Power[3]	0	0	0	0	w
Max Signal Plate Dissipation[2]	370	400	400	400	W

MAXIMUM RATINGS (Frequencies to 30 MHz, Intermittent Service

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	270	WATTS
SCREEN DISSIPATION[2]	35	WATTS
GRID DISSIPATION[2]	10	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz, Intermittent Service)

Plate Voltage	2000	2500	3000	3650	Vdc
Screen Voltage	500	500	500	500	Vdc
Grid Voltage	-220	-220	-220	-225	Vdc
Plate Current	275	275	275	275	mAdc
Screen Current[1]	30	28	26	23	mAdc
Screen Dissipation	15	14	13	12	W
Grid Current[1]	12	12	12	13	mAdc
Grid Dissipation	1.1	1.1	1.1	1.2	W
Peak Screen Voltage (100% modulation)	350	350	350	350	v
Peak rf Grid Voltage[1]	290	290	290	315	v
Calculated Driving Power[1]	3.5	3.5	3.5	4.0	W
Plate Input Power	550	688	825	1000	W
Plate Dissipation	170	178	195	235	W
Plate Output Power	380	510	630	765	W
Plate Output Power	850	1100	1330	1540	W
Load Resistance (plate to plate)	6800	8900	11,500	14,000	Ω

TYPICAL OPERATION (Two Tubes) Class AB_2

Plate Voltage	2500	3000	3500	4000	Vdc
Screen Voltage	500	500	500	500	Vdc
Grid Voltage[1/4]	-75	-80	-85	-90	Vdc
Zero-Signal Plate Current	190	160	140	120	mAdc
Max. Signal Plate Current	700	700	700	638	mAdc
Zero-Signal Screen Current	0	0	0	0	mAdc
Max. Signal Screen Current	50	40	38	32	mAdc
Peak af Grid Voltage[2]	133	140	145	140	v
Peak Driving Power[3]	8.6	9.0	10.2	7.0	W
Max. Signal Plate Dissipation[2]	320	363	400	400	W
Plate Output Power	1110	1375	1650	1750	W
Load Resistance (plate to plate)	7200	9100	10,800	14,000	Ω

1. Approximate value.
2. Per tube.
3. Nominal drive power is one-half peak power.
4. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 5.0 volts	13.5	14.7	A
Interelectrode Capacitances [1] (grounded filament connection):			
Input	10.7	14.5	pF
Output	4.2	5.6	pF
Feedback	----	0.17	pF

1. In Shielded Fixture.

APPLICATION

MECHANICAL

MOUNTING - The 4-400A must be mounted vertically, base up or down. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the EIMAC SK-400 and SK-410 Air-System Sockets. A flexible connecting strap should be provided between the EIMAC HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

COOLING - Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C.

When the EIMAC SK-400 or SK-410 Air-System Socket is used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water or less, as measured in the socket or plenum chamber at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

In the event an Air-System Socket is not used, provision must be made to supply equivalent cooling of the base, the envelope, and the plate lead.

Tube temperatures may be measured with a temperature sensitive paint, spray or crayon, such as manufactured by Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, N.J. 07080.

ELECTRICAL

FILAMENT VOLTAGE - For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 5.0 volts. Variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

BIAS VOLTAGE - The dc bias voltage for the 4-400A should not exceed 500 volts. If grid resistor bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 MHz, it is advisable to keep the bias voltage as low as is practicable.

SCREEN VOLTAGE - The dc screen voltage for the 4-400A should not exceed 800 volts. The screen voltages shown under Typical Operation are representative voltages for the type of operation involved.

PLATE VOLTAGE - The plate-supply voltage for the 4-400A should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the dc plate-supply voltage should not exceed 3200 volts, except below 30 MHz, intermittent service, where 4000 volts may be used.

GRID DISSIPATION - Grid dissipation for the 4-400A should not be allowed to exceed 10 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{gk} \times I_c$$

where P_g = Grid dissipation

e_{gk} = Peak positive grid to cathode voltage, and

I_c = dc grid current

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.

SCREEN DISSIPATION - The power dissipated by the screen of the 4-400A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

PLATE DISSIPATION - Under normal operating conditions, the plate dissipation of the 4-400A should not be allowed to exceed 400 watts. The anode of the 4-400A operates at a visibly red color at its maximum rated dissipation of 400 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

PULSE SERVICE - For pulse service, the EIMAC 4PR400A should be used.

MULTIPLE OPERATION - To obtain maximum power output with minimum distortion from tubes operated in multiple, it is desirable to adjust individual screen or grid bias voltages so that the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual dc plate currents will be approximately equal for full input signal for class AB_1 operation.

CAUTION - GLASS IMPLOSION - The EIMAC 4-400A is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

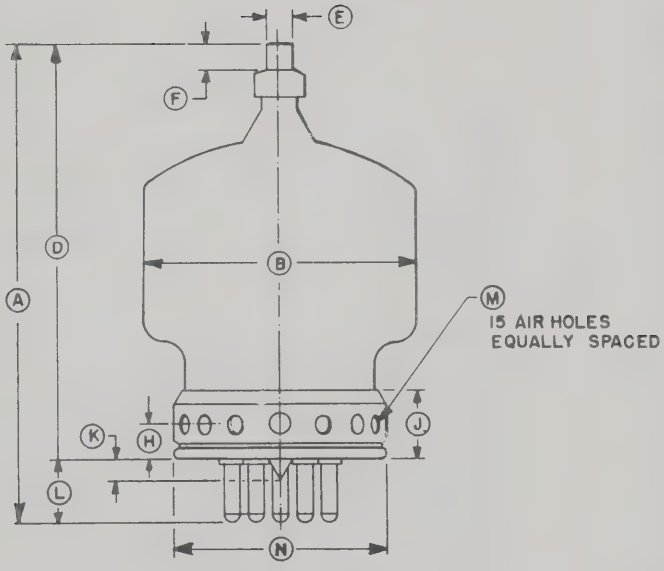
CAUTION-HIGH VOLTAGE - Operating voltage for the 4-400A can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

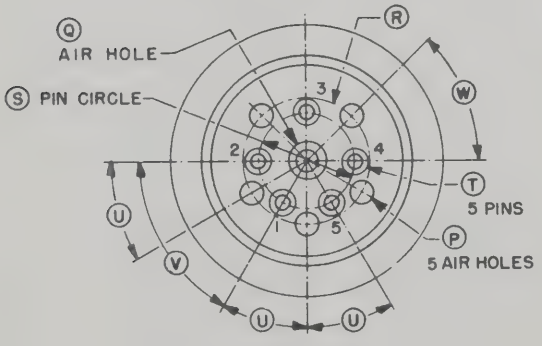
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

DIMENSIONAL DATA

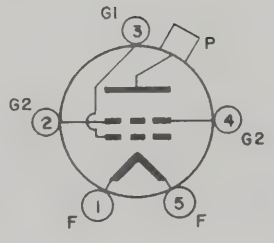
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX	REF.	MIN.	MAX.	REF.
A	5.875	6.375	--	149.23	161.93	--
B	--	3.563	--	--	90.50	--
D	5.125	5.625	--	130.18	142.88	--
E	0.350	0.365	--	8.89	9.27	--
F	0.328	--	--	8.33	--	--
H	--	--	0.438	--	--	11.13
J	--	0.969	--	--	24.61	--
K	--	0.250	--	--	6.35	--
L	--	--	0.750	--	--	19.05
M	--	--	0.250	--	--	6.35
N	--	2.750	--	--	69.85	--
P	--	--	0.312	--	--	7.92
Q	--	--	0.500	--	--	12.70
R	--	--	1.625	--	--	41.28
S	--	--	1.250	--	--	31.75
T	0.185	0.191	--	4.70	4.85	--
U	--	--	30°	--	--	30°
V	--	--	60°	--	--	60°
W	--	--	45°	--	--	45°

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

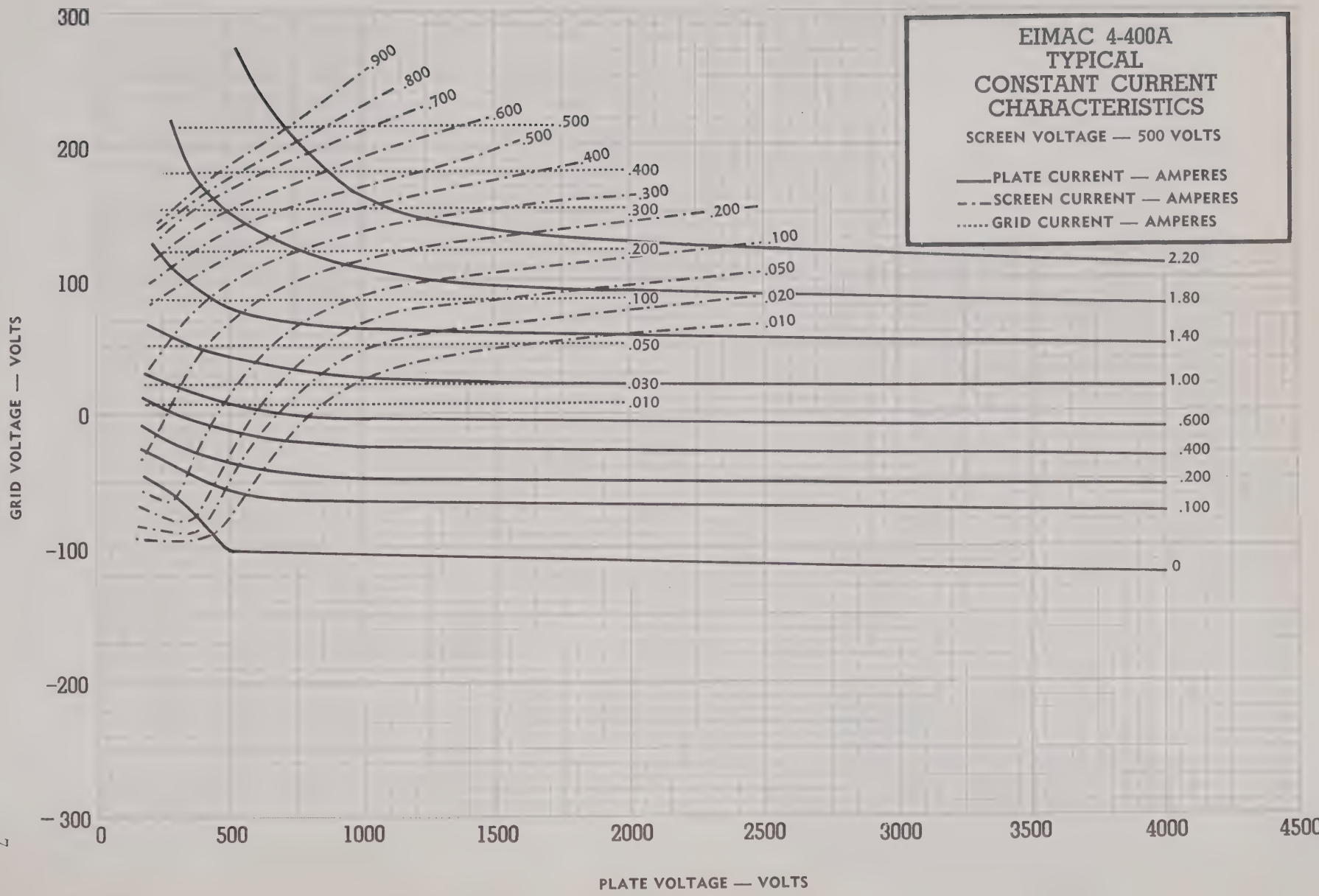




BOTTOM VIEW



NOTE:
Base pins T and tubulation K are so alined that they can be freely inserted in a gage ¼ inch (6.35 mm) thick with hole diameters of .204 (5.18 mm) and .500 (12.70 mm), respectively, located on the true centers by the given dimensions S, U, V.


EIMAC 4-400A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
300
200
100
0
−100
−200
−300
0
500
1000
1500
2000
2500
3000
3500
4000
4500
.900
.800
.700
.600
.500
.500
.400
.400
.300
.300
.200
.200
.100
.100
.050
.050
.020
.030
.010
.010
2.20
1.80
1.40
1.00
.600
.400
.200
.100
0

TECHNICAL DATA

6775
4-400C

RADIAL BEAM
POWER TETRODE

The EIMAC 6775/4-400C is a compact, ruggedly constructed, broadcast-quality tetrode having a maximum plate dissipation rating of 400 watts. It is intended for use as an amplifier, oscillator, or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

The 6775/4-400C is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an EIMAC SK-400 Series Air-System Socket, and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.[1]

The 6775/4-400C is especially recommended for applications where long life and consistent performance are of prime consideration.[2]



GENERAL CHARACTERISTICS[3]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0 ± 0.25	V
Current, at 5.0 volts	14.7	A
Transconductance (Average):		
I_b = 100 mA, E_{c2} = 500 volts	4000	μmhos
Amplification Factor (Average):		
Grid to Screen	5.1	
Direct Interelectrode Capacitances (grounded filament)[4]		
Cin	12.5	pF
Cout	4.7	pF
Cgp	0.12	pF
Frequency of Maximum Rating:		
CW	110	MHz

1. Guarantee applies only when the 4-400C is used as specified with adequate cooling air in the SK-400 or SK-410 Air-System Socket and associated chimney, or equivalents.
2. See FILAMENT VOLTAGE section for recommended operating conditions when long life and consistent performance are of prime concern.
3. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
4. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

(Effective 4-1-71) © by Varian

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MECHANICAL

Maximum Overall Dimensions:	
Length	6.375 in; 161.93 mm
Diameter	3.563 in; 90.50 mm
Net Weight	9.0 oz; 255 gm
Operating Position	Any
Maximum Operating Temperature:	
Plate Seal	225°C
Base Seals	200°C
Cooling	Radiation and forced air
Base	Special 5-pin
Recommended Socket	EIMAC SK-400 Series
Recommended Chimney	EIMAC SK-406
Recommended Heat-Dissipating Connectors:	
Plate	HR-6

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB_1

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	800	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Frequencies to 75 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	3000	Vdc
Screen Voltage	750	Vdc
Grid Voltage[1]	-130	Vdc
Zero-Signal Plate Current	80	mAdc
Single-Tone Plate Current	290	mAdc
Single-Tone Screen Current[2]	13	mAdc
Useful Output Power	470	w
Resonant Load Impedance	5000	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony (Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Frequencies to 75 MHz)

Plate Voltage	2500	3000	4000	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-200	-220	-220	Vdc
Plate Current	350	350	350	mAdc
Screen Current[1]	46	46	40	mAdc
Screen Dissipation	23	23	20	W
Grid Current[1]	18	19	18	mAdc
Peak rf Grid Voltage[1]	300	320	320	v
Grid Dissipation	1.8	1.9	1.8	W
Calculated Driving Power[2]	5.4	6.1	5.8	W
Plate Input Power	875	1050	1400	W
Plate Dissipation	235	250	300	W
Plate Output Power	640	800	1100	W

1. Approximate value.
2. Driving Power increases with frequency. At 75 MHz driving power is approximately 12 watts.

TYPICAL OPERATION (110 MHz, two tubes)

Plate Voltage	3000	4000	Vdc
Screen Voltage	500	500	Vdc
Grid Voltage	-170	-170	Vdc
Plate Current	500	540	mAdc
Screen Current	34	31	mAdc
Grid Current	20	20	mAdc
Driving Power[1]	20	20	W
Plate Output Power[1]	1300	1600	W
Useful Output Power	1160	1440	W

1. Approximate value

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	3200	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	270	WATTS
SCREEN DISSIPATION[2]	35	WATTS
GRID DISSIPATION[2]	10	WATTS

1. Corresponds to 400 watts at 100% sine-wave modulation.

TYPICAL OPERATION (Frequencies to 75 MHz, Continuous Service)

Plate Voltage	2000	2500	3000	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-220	-220	-220	Vdc
Plate Current	275	275	275	mAdc
Screen Current[1]	30	28	26	mAdc
Screen Dissipation	15	14	13	W
Grid Current[1]	12	12	12	mAdc
Grid Dissipation	1.1	1.1	1.1	W
Peak af Screen Voltage[1] (100% modulation)	350	350	350	v
Peak rf Grid Voltage[1]	290	290	290	v
Calculated Driving Power[1]	3.5	3.5	3.5	W
Plate Input Power	550	688	825	W
Plate Dissipation	170	178	195	W
Plate Output Power	380	510	630	W

1. Approximate value.

MAXIMUM RATINGS (Frequencies to 30 MHz, Intermittent Service)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION[1]	270	WATTS
SCREEN DISSIPATION[2]	35	WATTS
GRID DISSIPATION[2]	10	WATTS

2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz, Intermittent Service)

Plate Voltage	2000	2500	3000	3650	Vdc
Screen Voltage	500	500	500	500	Vdc
Grid Voltage	-220	-220	-220	-225	Vdc
Plate Current	275	275	275	275	mAdc
Screen Current[1]	30	28	26	23	mAdc
Screen Dissipation	15	14	13	12	W
Grid Current[1]	12	12	12	13	mAdc
Grid Dissipation	1.1	1.1	1.1	1.2	W
Peak Screen Voltage (100% modulation)	350	350	350	350	v
Peak rf Grid Voltage[1]	290	290	290	315	v
Calculated Driving Power[1]	3.5	3.5	3.5	4.0	W
Plate Input Power	550	688	825	1000	W
Plate Dissipation	170	178	195	235	W
Plate Output Power	380	510	630	765	W

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	800	VOLTS
DC PLATE CURRENT	0.350	AMPERE
PLATE DISSIPATION	400	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	10	WATTS

TYPICAL OPERATION (Two Tubes) Class AB_1

Plate Voltage	2500	3000	3500	4000	Vdc
Screen Voltage	750	750	750	750	Vdc
Grid Voltage[1]/4	-130	-137	-145	-150	Vdc
Zero-Signal Plate Current	190	160	140	120	mAdc
Max.Signal Plate Current	635	635	610	585	mAdc
Zero-Signal Screen Current	0	0	0	0	mAdc
Max.Signal Screen Current[1]	28	26	32	40	mAdc
Peak af Grid Voltage[2]	130	137	145	150	v
Peak Driving Power[3]	0	0	0	0	w
Max Signal Plate Dissipation[2]	370	400	400	400	W
Plate Output Power	850	1100	1330	1540	W
Load Resistance (plate to plate)	6800	8900	11,500	14,000	Ω

TYPICAL OPERATION (Two Tubes) Class AB_2

Plate Voltage	2500	3000	3500	4000	Vdc
Screen Voltage	500	500	500	500	Vdc
Grid Voltage[1]/4	-75	-80	-85	-90	Vdc
Zero-Signal Plate Current	190	160	140	120	mAdc
Max.Signal Plate Current	700	700	700	638	mAdc
Zero-Signal Screen Current	0	0	0	0	mAdc
Max.Signal Screen Current	50	40	38	32	mAdc
Peak af Grid Voltage[2]	133	140	145	140	v
Peak Driving Power[3]	8.6	9.0	10.2	7.0	w
Max.Signal Plate Dissipation[2]	320	363	400	400	W
Plate Output Power	1110	1375	1650	1750	W
Load Resistance (plate to plate)	7200	9100	10,800	14,000	Ω

1. Approximate value.
2. Per Tube.
3. Nominal drive power is one-half peak power.
4. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 5.0 volts	14.0	15.3	A
Interelectrode Capacitances [1](grounded filament connection):			
Cin	10.7	14.5	pF
Cout	4.2	5.6	pF
Cgp	----	0.17	pF

1. In Shielded Fixture, per EIA Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4-400C may be operated in any position. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the EIMAC SK-400 and SK-410 Air-System Sockets. A flexible connecting strap should be provided between the EIMAC HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

COOLING - Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C.

When the EIMAC SK-400 or SK-410 Air-System Socket is used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water or less, as measured in the socket or plenum chamber at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

Tube temperatures may be measured with a temperature sensitive paint, spray or crayon, such as manufactured by Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, N.J. 07080.

ELECTRICAL

FILAMENT VOLTAGE - Filament voltage should be measured at the tube base with an accurate meter. When operating at the nominal voltage, variations of ±5% are tolerable and should have little effect on electrical performance of the tube. However, when very long life and consistent performance are factors, voltage can often be reduced to a value lower than the nominal voltage, but should be regulated and held to ±1% when this is done. To achieve a regulated voltage and still have it adjustable, a typical procedure would involve a one-to-one regulating transformer, feeding a variable ratio transformer (such as a POWERSTAT or a VARIAC), which in turn feeds the filament transformer. The equipment is first operated with nominal filament voltage applied, and when stable operation is achieved, the voltage is then reduced in small steps (about 0.2 volt at a time) until the point is reached where performance of the tube is clearly affected. The voltage is then

raised to a few tenths of a volt above this level for operation. Periodically (every 500 to 1000 hours) this procedure should be repeated and the operating value of the filament voltage readjusted if necessary.

BIAS VOLTAGE - The dc bias voltage for the 4-400C should not exceed 500 volts. If grid resistor bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 MHz, it is advisable to keep the bias voltage as low as is practicable.

SCREEN VOLTAGE - The dc screen voltage for the 4-400C should not exceed 800 volts. The screen voltages shown under Typical Operation are representative voltages for the type of operation involved.

PLATE VOLTAGE - The plate-supply voltage for the 4-400C should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the dc plate-supply voltage should not exceed 3200 volts, except below 30 MHz, intermittent service, where 4000 volts may be used.

GRID DISSIPATION - Grid dissipation for the 4-400C should not be allowed to exceed 10 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{gk} \times I_c$$

where P_g = Grid dissipation
e_{gk} = Peak positive grid to cathode voltage, and
I_c = dc grid current

SCREEN DISSIPATION - The power dissipated by the screen of the 4-400C must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

PLATE DISSIPATION - Under normal operating conditions, the plate dissipation of the 4-400C should not be allowed to exceed 400 watts. The anode operates at a visibly red color at its maximum rated dissipation of 400 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

MULTIPLE OPERATION - To obtain maximum power output with minimum distortion from tubes operated in multiple, it is desirable to adjust individual screen or grid bias voltages so that the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual dc plate currents will be approximately equal for full input signal for class AB1 operation.

CAUTION - GLASS IMPLOSION - The EIMAC 4-400C is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

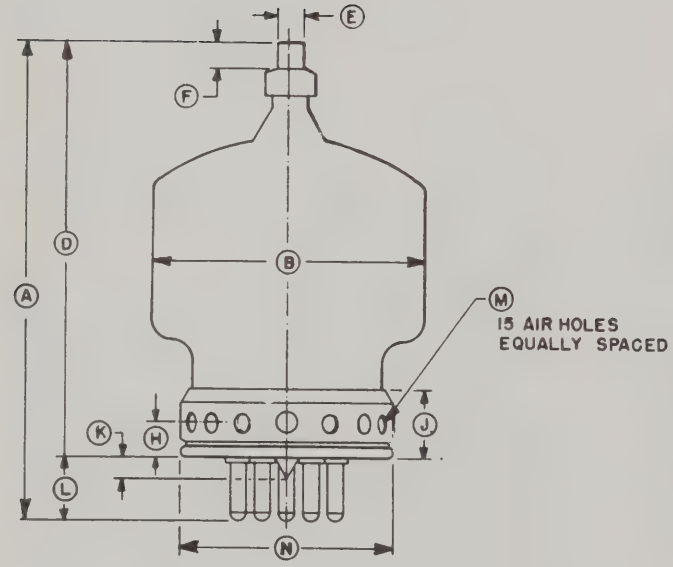
CAUTION-HIGH VOLTAGE - Operating voltage for the 4-400C can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

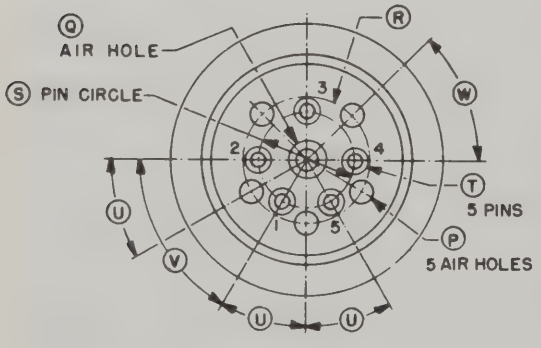
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

DIMENSIONAL DATA

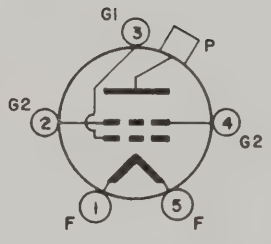
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	5.875	6.375	--	149.23	161.93	--
B	--	3.563	--	--	90.50	--
D	5.125	5.625	--	130.18	142.88	--
E	0.350	0.365	--	8.89	9.27	--
F	0.328	--	--	8.33	--	--
H	--	--	0.438	--	--	11.13
J	--	0.969	--	--	24.61	--
K	--	0.250	--	--	6.35	--
L	--	--	0.750	--	--	19.05
M	--	--	0.250	--	--	6.35
N	--	2.750	--	--	69.85	--
P	--	--	0.312	--	--	7.92
Q	--	--	0.500	--	--	12.70
R	--	--	1.625	--	--	41.28
S	--	--	1.250	--	--	31.75
T	0.185	0.191	--	4.70	4.85	--
U	--	--	30°	--	--	30°
V	--	--	60°	--	--	60°
W	--	--	45°	--	--	45°

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

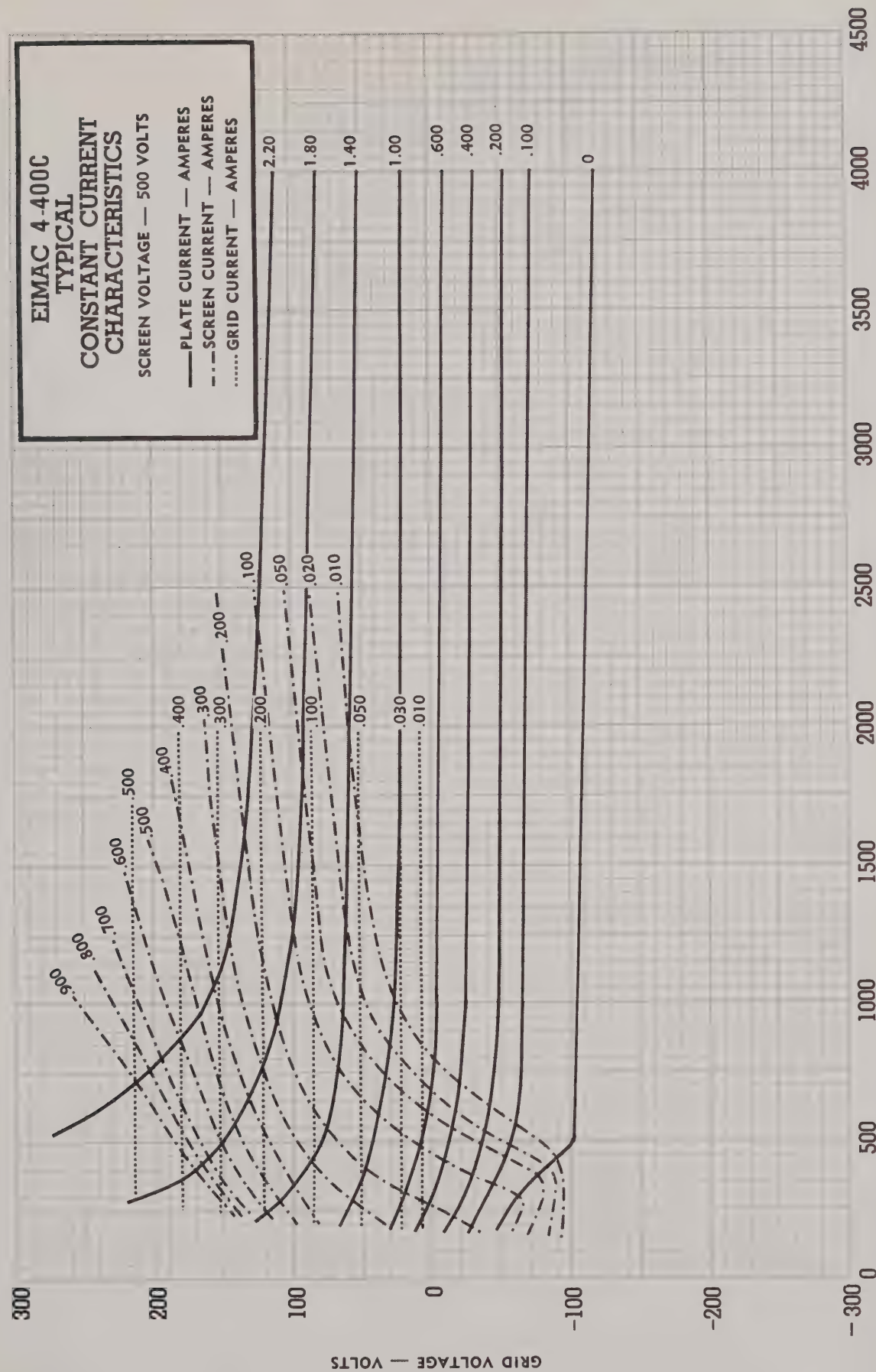




BOTTOM VIEW



NOTE:
Base pins T and tubulation K are so alined that they can be freely inserted in a gage ¼ inch (6.35 mm) thick with hole diameters of .204 (5.18 mm) and .500 (12.70 mm), respectively, located on the true centers by the given dimensions S, U, V.


EIMAC 4-400C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
——PLATE CURRENT — AMPERES
- - -SCREEN CURRENT — AMPERES
.....GRID CURRENT — AMPERES
2.20
1.80
1.40
1.00
.600
.400
.200
.100
0
.100
.050
.020
.010
.200
.100
.050
.030
.010
.300
.300
.400
.400
.500
.500
.600
.700
.800
.900
300
200
100
0
-100
-200
-300
0
500
1000
1500
2000
2500
3000
3500
4000
4500
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

4–500A

TECHNICAL DATA

RADIAL BEAM
POWER TETRODE

The EIMAC 4-500A is a compact, ruggedly constructed, broadcast-quality tetrode having a maximum plate dissipation rating of 500 watts. It is intended for use as an amplifier, oscillator, or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

The 4-500A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an EIMAC SK-400 Series Air-System Socket, and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.

The 4-500A is especially recommended for applications where long life and consistent performance are of prime consideration.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	10.0 ± 0.5 V
Current, at 10.0 volts	10.2 A
Amplification Factor (Average):	
Grid to Screen	5.5
Direct Interelectrode Capacitances (grounded filament)[2]	
Cin	15.0 pF
Cout	5.0 pF
Cgp	0.15 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	7.000 in; 177.80 mm
Diameter	3.562 in; 90.47 mm
Net Weight	8.7 oz; 245 gm

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Operating Position	Vertical, base up or down
Maximum Operating Temperature:	
Plate Seal	225° C
Base Seals	200° C
Cooling	Radiation and forced air
Base	Special 5-pin
Recommended Socket	EIMAC SK-410
Recommended Chimney	EIMAC SK-426
Recommended Heat-Dissipation Connectors:	
Plate	HR-6

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN Class AB_1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	1000	VOLTS
DC PLATE CURRENT	0.450	AMPERE
PLATE DISSIPATION	500	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	12	WATTS

1. Adjust for specified zero-signal plate current.
2. Approximate values.
3. The intermodulation distortion products are referenced against one tone of a two-equal-tone signal.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	2500	3000	4000	Vdc
Screen Voltage	750	750	750	Vdc
Grid Voltage [1]	-117	-130	-140	Vdc
Zero-Signal Plate Current	150	100	80	mAdc
One-Tone Plate Current	338	320	322	mAdc
Two-Tone Plate Current	254	225	215	mAdc
Zero-Sig. Screen Current [2]	0	0	0	mAdc
One-Tone Screen Current [2]	38	36	32	mAdc
Two-Tone Screen Current [2]	12	10	8	mAdc
Peak rf Grid Voltage [2]	103	116	126	v
Plate Dissipation	418	427	500	W
One-Tone Plate Output Power	427	533	773	W
Resonant Load Impedance	3700	4800	6500	Ω
IMD Products [3]				
3rd Order	-33	-33	-29	dB
5th Order	-38	-35	-34	dB

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Class C Telegraphy or FM Telephony - Key Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC PLATE CURRENT	0.450	AMPERE
PLATE DISSIPATION	500	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	12	WATTS

1. Approximate value.
2. Driving power increases with frequency. Values shown are calculated or measured at Low Frequency.

TYPICAL OPERATION (Frequencies to 75 MHz)

Plate Voltage	2500	3000	3800	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-265	-270	-280	Vdc
Plate Current	402	428	445	mAdc
Screen Current [1]	34	48	49	mAdc
Peak rf Grid Voltage [1]	365	380	390	v
Driving Power [2]	6.6	8.4	9.0	W
Plate Input Power	1005	1285	1685	W
Plate Dissipation	360	395	420	W
Plate Output Power	645	890	1265	W
Resonant Load Impedance	2520	2970	4030	Ω

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER - GRID DRIVEN

Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3200	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC GRID VOLTAGE	-500	VOLTS
DC PLATE CURRENT	0.35	AMPERE
PLATE DISSIPATION [1]	335	WATTS
SCREEN DISSIPATION [2]	35	WATTS
GRID DISSIPATION [2]	12	WATTS

1. Corresponds to 500 watts at 100% sine-wave modulation.
2. Average, with or without modulation.
3. Approximate value.
4. Driving power increases with frequency. Values shown are calculated for low frequency.

TYPICAL OPERATION (Frequencies to 30 MHz)
(Continuous Service)

Plate Voltage	2700	3200	Vdc
Screen Voltage	500	500	Vdc
Grid Voltage	-280	-300	Vdc
Plate Current	338	337	mAdc
Screen Current [3]	30	40	mAdc
Grid Current [3]	12	15	mAdc
Peak af Screen Voltage [3] (100% modulation)	500	500	v
Peak rf Grid Voltage [3]	360	380	v
Calculated Driving Power [4]	4.3	5.8	W
Plate Input Power	915	1075	W
Plate Dissipation	245	245	W
Plate Output Power	670	830	W
Resonant Load Impedance	3610	4390	Ω

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven, Sinusoidal Wave

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	1000	VOLTS
DC PLATE CURRENT	0.450	AMPERE
PLATE DISSIPATION	500	WATTS
SCREEN DISSIPATION	35	WATTS
GRID DISSIPATION	12	WATTS

1. Approximate value.
2. Per tube.
3. Adjust to give stated zero-signal plate current.

TYPICAL OPERATION (Two Tubes - Class AB_1)

Plate Voltage	3000	3800	Vdc
Screen Voltage	750	750	Vdc
Grid Voltage[1/3]	-138	-150	Vdc
Zero-Signal Plate Current	200	150	mAdc
Max. Signal Plate Current	735	715	mAdc
Zero-Signal Screen Current	0	0	mAdc
Max. Signal Screen Current[1]	16	16	mAdc
Max. Signal Grid Current	0	0	mAdc
Peak af Grid Voltage[2]	123	135	v
Peak Driving Power	0	0	w
Max. Signal Plate Dissipation	480	500	W
Plate Output Power	1240	1720	W
Load Resistance (tube-to-tube)	7800	10500	Ω

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 10.0 volts	9.7	11.2	A
Interelectrode Capacitances[1] (grounded filament connection):			
Cin	13.0	17.0	pF
Cout	4.0	6.0	pF
Cgp	---	0.20	pF

1. In Shielded Fixture, per EIA Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4-500A must be mounted vertically. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the EIMAC SK-410 Air-System Socket. A flexible connecting strap should be provided between the EIMAC HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

COOLING - Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C.

When the EIMAC SK-410 Socket and SK-426 Chimney are used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water or less, as measured in the socket or plenum chamber at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

Tube temperatures may be measured with a temperature sensitive paint, spray or crayon, such as manufactured by Tempil Division, Big Three Industrial Gas & Equipment Co., Hamilton Blvd., So. Plainfield, N.J. 07080.

ELECTRICAL

FILAMENT VOLTAGE - Filament voltage should be measured at the tube base with an accurate meter. When operating at the nominal

voltage, variations of ±5% are tolerable and should have little effect on electrical performance of the tube. However, when very long life and consistent performance are factors, voltage can often be reduced to a value lower than the nominal voltage, but should be regulated and held to ±1% when this is done. To achieve a regulated voltage and still have it adjustable, a typical procedure would involve a one-to-one regulating transformer, feeding a variable ratio transformer (such as a POWERSTAT or a VARIAC), which in turn feeds the filament transformer. The equipment is first operated with nominal filament voltage applied, and when stable operation is achieved, the voltage is then reduced in small steps (about 0.2 volt at a time) until the point is reached where performance of the tube is clearly affected. The voltage is then raised to a few tenths of a volt above this level for operation. Periodically (every 500 to 1000 hours) this procedure should be repeated and the operating value of the filament voltage readjusted if necessary.

BIAS VOLTAGE - The dc bias voltage for the 4-500A should not exceed 500 volts. If grid resistor bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 MHz, it is advisable to keep the bias voltage as low as is practicable.

SCREEN VOLTAGE - The dc screen voltage for the 4-500A should not exceed 1000 volts. The screen voltages shown under Typical Operation are representative voltages for the type of operation involved.

PLATE VOLTAGE - The plate-supply voltage for the 4-500A should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the dc plate-supply voltage should not exceed 3200 volts, except below 30 MHz, intermittent service, where 4000 volts may be used.

GRID DISSIPATION - Grid dissipation for the 4-500A should not be allowed to exceed 12 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{gk} \times I_c$$

where P_g = Grid dissipation
e_{gk} = Peak positive grid to cathode voltage, and
I_c = dc grid current

SCREEN DISSIPATION - The power dissipated by the screen of the 4-500A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

PLATE DISSIPATION - Under normal operating conditions, the plate dissipation of the 4-500A should not be allowed to exceed 500 watts. The anode operates at a visibly red color at its maximum rated dissipation of 500 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 335 watts. The plate dissipation will rise to 500 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

MULTIPLE OPERATION - To obtain maximum power output with minimum distortion from tubes operated in multiple, it is desirable to adjust individual screen or grid bias voltages so that the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual dc plate currents will be approximately equal for full input signal for class AB1 operation.

CAUTION-GLASS IMPLOSION - The EIMAC 4-500A is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

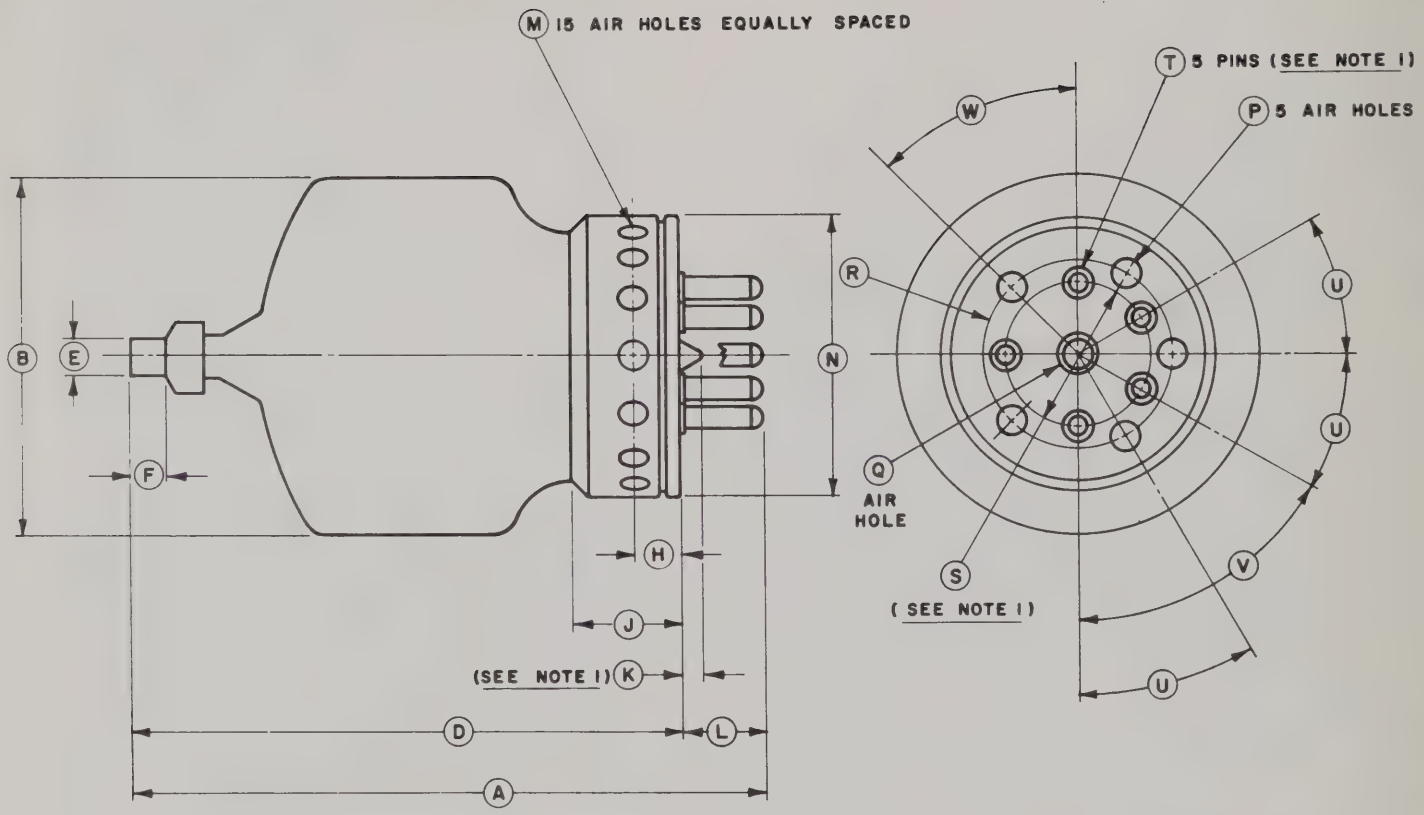
CAUTION-HIGH VOLTAGE - Operating voltage for the 4-500A can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that

no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

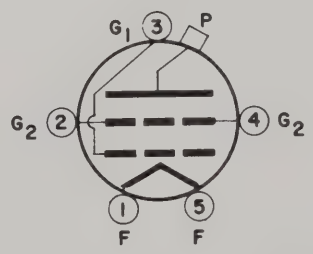
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

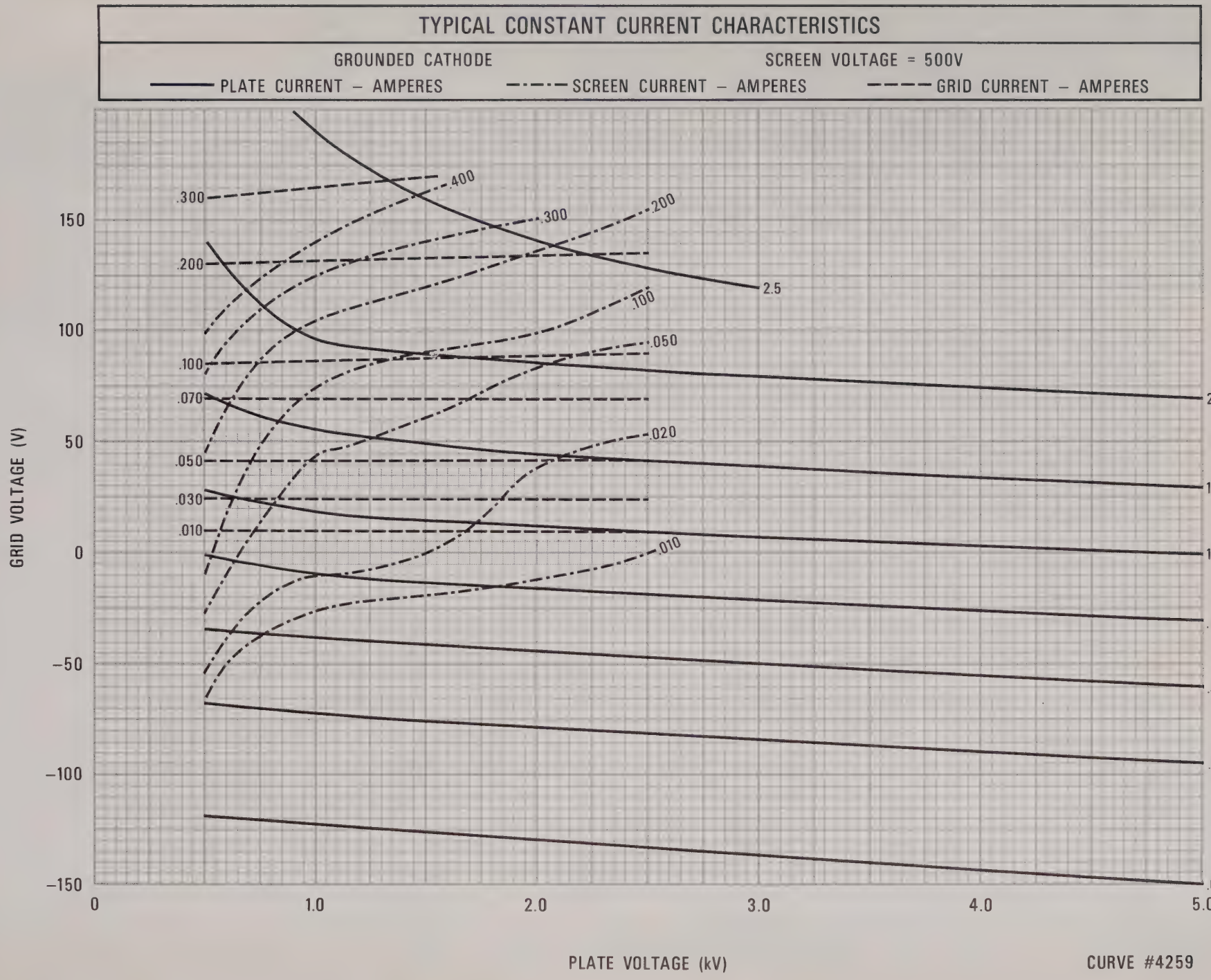


DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	6.500	7.000	- -	165.10	177.80	- -
B	- -	3.562	- -	- -	90.47	- -
D	5.750	6.250	- -	146.05	158.75	- -
E	0.350	0.365	- -	8.89	9.27	- -
F	0.328	- -	- -	8.33	- -	- -
H	- -	- -	0.468	- -	- -	11.89
J	- -	- -	1.125	- -	- -	28.57
K	- -	0.250	- -	- -	6.35	- -
L	- -	- -	0.750	- -	- -	19.05
M	- -	- -	0.250	- -	- -	6.35
N	- -	2.750	- -	- -	69.85	- -
P	- -	- -	0.312	- -	- -	7.92
Q	- -	- -	0.500	- -	- -	12.70
R	- -	- -	1.625	- -	- -	41.27
S	- -	- -	1.250	- -	- -	31.75
T	0.185	0.191	- -	4.70	4.85	- -
U	- -	- -	30°	- -	- -	30°
V	- -	- -	60°	- -	- -	60°
W	- -	- -	45°	- -	- -	45°

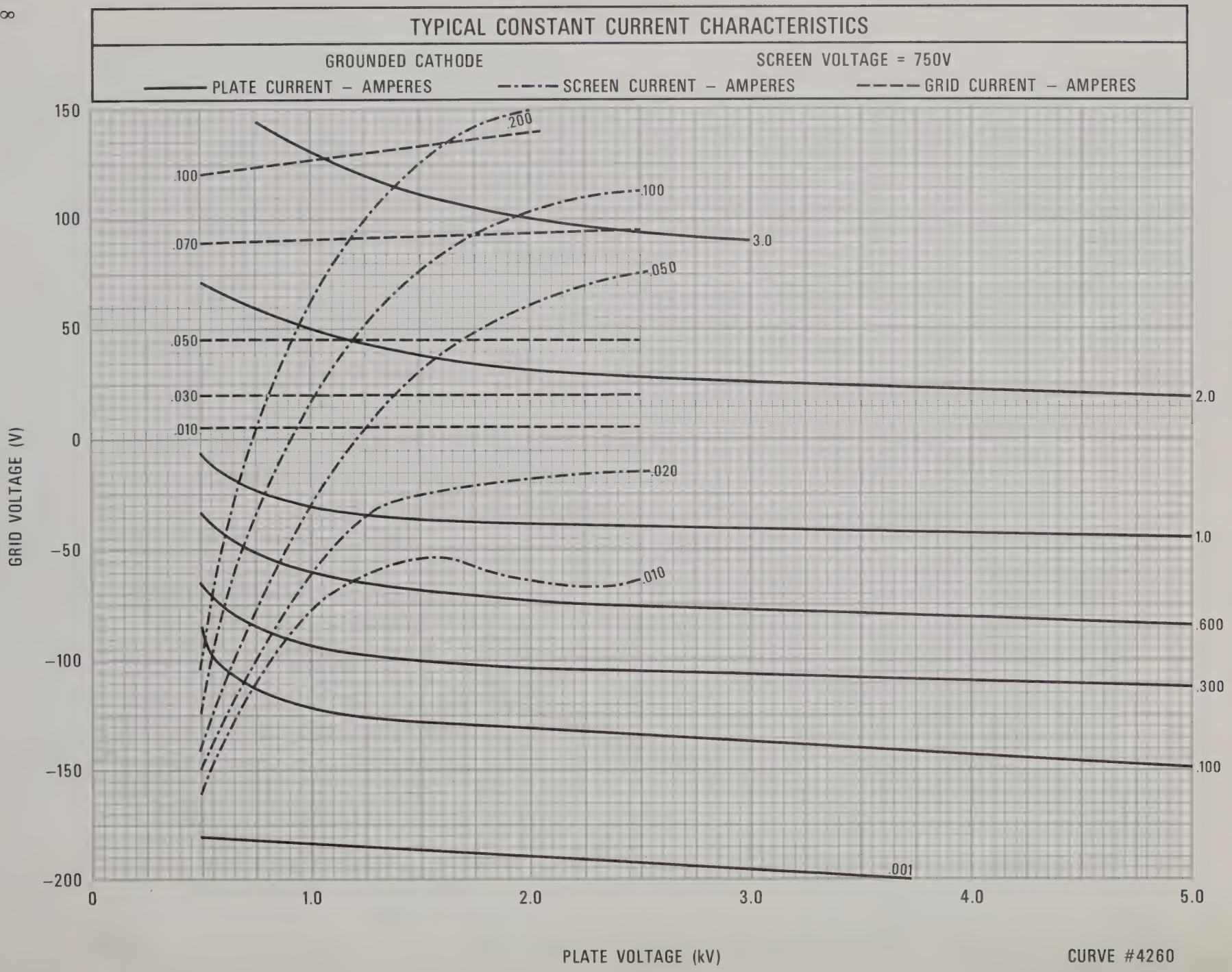


NOTES:

1. BASE PINS (T) & TUBULATION (K) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4 THICK WITH HOLE DIA'S OF .204 & .500 RESPECTIVELY LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS (V), (U) & (S).
2. REF. DIM'S ARE FOR INFO. ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
150
100
50
0
–50
–100
–150
0
1.0
2.0
3.0
4.0
5.0
PLATE VOLTAGE (kV)
.300
.200
.100
.070
.050
.030
.010
.400
.300
.200
.100
.050
.020
.010
2.5
2.0
1.5
1.0
.600
.300
.100
.001

CURVE #4259


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 750V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
150
100
50
0
–50
–100
–150
–200
0
1.0
2.0
3.0
4.0
5.0
PLATE VOLTAGE (kV)
.200
.100
.070
.050
.030
.010
.100
.050
.020
.010
.001
3.0
2.0
1.0
.600
.300
.100
CURVE #4260

Eimac®

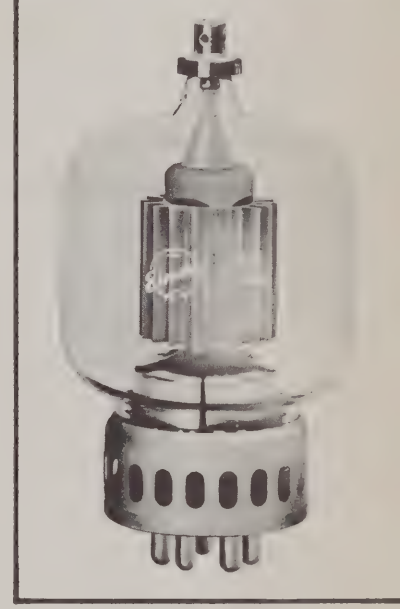
EITEL-McCULLOUGH, INC.

8166
4-1000A

RADIAL-BEAM POWER TETRODE

•

MODULATOR
OSCILATOR
AMPLIFIER



The Eimac 8166/4-1000A is a radial-beam tetrode with a maximum plate dissipation rating of 1000 watts. Intended for use as an amplifier, oscillator, or modulator, the 8166/4-1000A is capable of efficient operation well into the VHF range.

In FM broadcast service on 110 Megacycles, two 8166/4-1000A tetrodes will deliver a useful output power of over 5000 watts.

Operating under class AB_2 modulator conditions with less than 10 watts of peak driving power, two of these tubes will deliver 3900 watts of output power.

In class AB_1, a pair of 8166/4-1000A tetrodes will deliver 3800 watts of output power.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified through the use of the Eimac SK-500 Air-System Socket.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage	-	7.5		volts
Current	20.0		22.7	amperes
Amplification Factor (Grid to Screen)	6.1		7.7	
Direct Interelectrode Capacitances: †				
Grid-Plate	-	-	0.35	uuf
Input	23.8		32.4	uuf
Output	6.8		9.4	uuf
Transconductance (I_b=300 ma)		10,000		umhos
Highest Frequency for Maximum Ratings	-	-	110	mc

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommended Socket	Eimac SK-500 Air-System Socket
Operating Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Connector:	
Plate	Eimac HR-8
Maximum Over-all Dimensions:	
Length	9.63 inches
Diameter	5.25 inches
Net Weight (tube only)	1.5 pounds
Shipping Weight	12 pounds

†In Shielded Fixture

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed there will be little variation in output power between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, it is necessary to make the resistor adjustable to control plate current.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS (Key-down conditions, per tube to 110 Mc.)

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	700 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

TYPICAL OPERATION (Frequencies below 110 Mc., one tube)

D-C Plate Voltage	3000	4000	5000	6000 volts
D-C Screen Voltage	500	500	500	500 volts
D-C Grid Voltage	—150	—150	—200	—200 volts
D-C Plate Current	700	700	700	700 ma
D-C Screen Current	146	137	147	140 ma
D-C Grid Current	38	39	45	42 ma
Screen Dissipation	73	69	73	70 watts
Grid Dissipation	5	6	7	6 watts
Peak R-F Grid Input Voltage (approx.)	290	290	355	350 volts
Driving Power (approx.)*	11	12	16	15 watts
Plate Input Power	2100	2800	3500	4200 watts
Plate Dissipation	670	700	690	800 watts
Plate Output Power	1430	2100	2810	3400 watts

*Apparent driving power requirements increase above 30 Mc. At 110 Mc. the driver should be capable of supplying 200 watts per tube to take care of feed-through, circuit losses, and radiation.

TYPICAL OPERATION (110 Mc., two tubes, push-pull)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	450	500	500	volts
D-C Grid Voltage	—150	—160	—180	volts
D-C Plate Current	1.15	1.25	1.25	amps
D-C Screen Current	280	240	250	ma
D-C Grid Current	80	80	100	ma
Screen Dissipation (per tube)	63	60	63	watts
Driving Power (approx.)	350	400	400	watts
Plate Input Power	4600	6250	7500	watts
Plate Dissipation (per tube)	650	850	900	watts
Useful Output Power	3000	4200	5200	watts

These 110 Mc. typical performance figures were obtained by direct measurement in operating equipment. The output power is useful power measured in a load circuit. The driving power is that taken by the tube and a practical resonant circuit. In many cases with further refinement and improved techniques, better performance might be obtained.

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PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS (Per tube to 110 Mc.)

D-C PLATE VOLTAGE	5000 MAX. VOLTS†
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA
PLATE DISSIPATION	670 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

†5500 Max. volts below 30 Mc.

TYPICAL OPERATION (Frequencies below 110 Mc., one tube)

D-C Plate Voltage	3000	4000	5000	5500* volts
D-C Screen Voltage	500	500	500	500 volts
D-C Grid Voltage	—200	—200	—200	—200 volts
D-C Plate Current	600	600	600	600 ma
D-C Screen Current	145	132	130	105 ma
D-C Grid Current	36	33	33	28 ma
Screen Dissipation	72	66	65	52 watts
Grid Dissipation	5	4	4	3 watts
Peak A.F. Screen Voltage (100% modulation)	250	250	250	250 volts
Peak R-F Grid Input Voltage	340	335	335	325 volts
Driving Power**	12	11	11	9 watts
Plate Input Power	1800	2400	3000	3300 watts
Plate Dissipation	410	490	560	670 watts
Plate Output Power	1390	1910	2440	2630 watts

*5500 volt operation may be used below 30 Mc only.

**Apparent driving power requirements increase above 30 Mc. At 110 Mc. the driver should be capable of supplying 200 watts per tube to take care of feed-through, circuit losses, and radiation.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	700 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION

Class AB_1 (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	1000	1000	1000	volts
D-C Grid Voltage (approx.)*	—115	—125	—135	volts
Zero-Signal D-C Plate Current	300	240	200	ma
Max-Signal D-C Plate Current	1.05	1.00	0.95	amps
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	60	60	64	ma
Effective Load, Plate-to-Plate	7000	10,000	14,000	ohms
Peak A-F Grid Input Voltage (per tube)	115	125	135	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	930	950	930	watts
Max-Signal Plate Output Power	2340	3100	3840	watts

*Adjust to give stated zero-signal plate current. The D-C resistance in series with the control grid of each tube should not exceed 250,000 ohms.

TYPICAL OPERATION

Class AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage (approx.)*	—60	—70	—75	volts
Zero-Signal D-C Plate Current	300	200	150	ma
Max-Signal D-C Plate Current	1.20	1.10	.95	amps
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	95	90	65	ma
Effective Load, Plate-to-Plate	7000	11,000	15,000	ohms
Peak A-F Grid Input Voltage (per tube)	140	145	130	volts
Max-Signal Peak Driving Power	11.0	11.0	9.4	watts
Max-Signal Nominal Driving Power (approx.)	5.5	5.5	4.7	watts
Max-Signal Plate Dissipation (per tube)	900	850	900	watts
Max-Signal Plate Output Power	3000	3800	3900	watts

*Adjust to give stated zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATON AND RECOMMENDATIONS

APPLICATION

MECHANICAL

Mounting—The 4-1000A must be operated vertically. The base may be down or up. The recommended socket for this tube is the SK-500 Air-System Socket.

Cooling—Adequate forced-air cooling must be provided to maintain the base seal temperatures below 150°C and the plate seal temperature below 200°C. Cooling is simplified by the use of the Eimac SK-500 Air System Socket, and its SK-506 Air Chimney, which control the flow of air around the tube.

When the Eimac SK-500 Air-System Socket is used, the following flow rates apply to sea level operation, with an ambient temperature of 25°C for the operating conditions described:

At 110 megacycles, with maximum rated plate dissipation, an air-flow rate of 35 cfm is required. The corresponding pressure drop as measured in the socket is 1.9 inches of water column.

At frequencies below 30 megacycles, an air-flow rate of 20 cfm provides adequate cooling. The corresponding pressure drop as measured in the socket is 0.6 inch of water column.

In the event that an Air-System Socket and Air Chimney are not used, air must be circulated through the base of the tube and over the envelope surface and the plate seal in sufficient quantities to maintain the temperatures below the maximum ratings. Seal-temperature ratings may require that cooling air be supplied to the tube if the filament is maintained at operating temperature during standby periods.

In any questionable situation, the only criterion for correct cooling practice is temperature. A convenient medium for measuring tube temperatures is a temperature-sensitive paint.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 7.5 volts. Variations in filament voltage must be kept within the range of 7.13 to 7.87 volts.

Bias Voltage—The d-c bias voltage for the 4-1000A should not exceed 500 volts. With grid-leak bias, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation. The grid-resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In the case of operation above 50 megacycles, it is advisable to keep the bias voltage as low as possible.

Screen Voltage—The d-c screen voltage for the 4-1000A should not exceed 1000 volts. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

Plate Voltage—The plate-supply voltage for the 4-1000A should not exceed 6000 volts in CW and audio applications. In plate-modulated telephony service above 30 megacycles, the d-c plate-supply voltage should not exceed 5000 volts; however, below 30 megacycles, 5500-volts may be used.

Grid Dissipation—Grid dissipation for the 4-1000A should not be allowed to exceed 25 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where: P_g = Grid dissipation,
e_{cmp} = Peak positive grid to cathode voltage
I_c = D-C grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.

Screen Dissipation—The power dissipated by the screen of the 4-1000A must not exceed 75 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 75 watts in event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-1000A should not be allowed to exceed 1000 watts.

In plate-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 670 watts. The plate dissipation will rise to 1000 watts under 100 per-cent sinusoidal modulation.

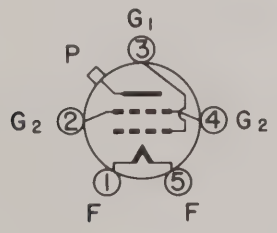
Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

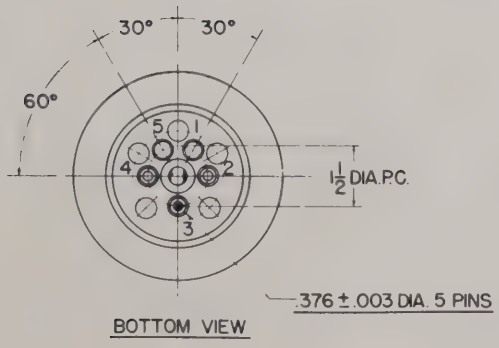
Neutralization—If reasonable precautions are taken to prevent coupling between input and output circuits, the 4-1000A may be operated up to the 10-megacycle region without neutralization. In the region between 10 megacycles and 30 megacycles, the conventional type of cross-neutralizing may be used with push-pull circuits. In single-ended circuits ordinary neutralization systems may be used which provide 180° out of phase voltage to the grid.

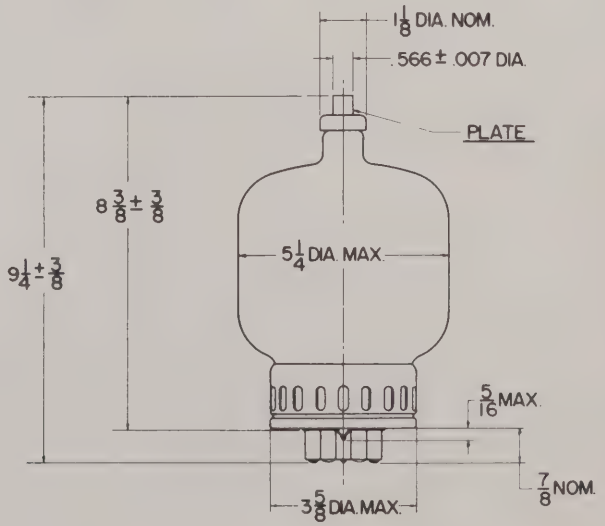
At frequencies above 30 megacycles the feedback is principally due to screen-lead-inductance effects. Feedback is eliminated by using series capacitance in the screen leads between the screen and ground. A variable capacitor of from 25 to 50 uufds will provide sufficient capacitance to neutralize each tube in the region of 100 megacycles. When using this method, the two screen terminals on the socket should be strapped together by the shortest possible lead. The lead from the mid-point of this screen strap to the variable capacitor and from the variable capacitor to ground should have as little inductance as possible.

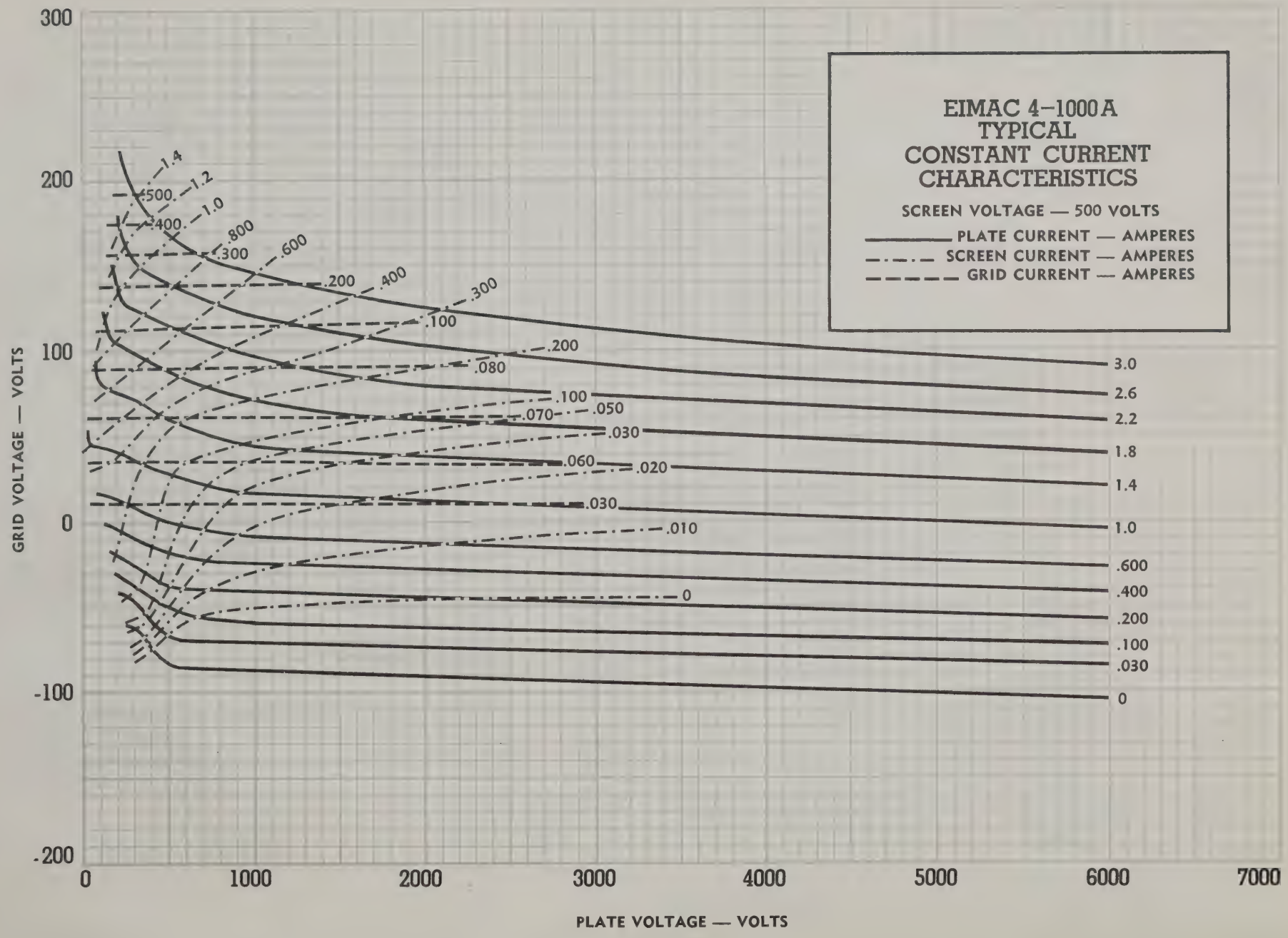
In general, plate, grid, filament, and screen-bypass or screen-neutralizing capacitors should be returned to r-f ground through the shortest possible leads.

In order to take full advantage of the high power gain obtainable with the 4-1000A, care should be taken to prevent feedback from the output to input circuits. A conventional method of obtaining the necessary shielding between the grid and plate circuits is to use a suitable metal chassis with the grid circuit mounted below the deck and the plate circuit mounted above the deck. Power-supply leads entering the amplifier should be bypassed to ground and properly shielded to avoid feedback coupling in these leads. The output circuit and antenna feeders should be arranged so as to preclude any possibility of feedback into other circuits.





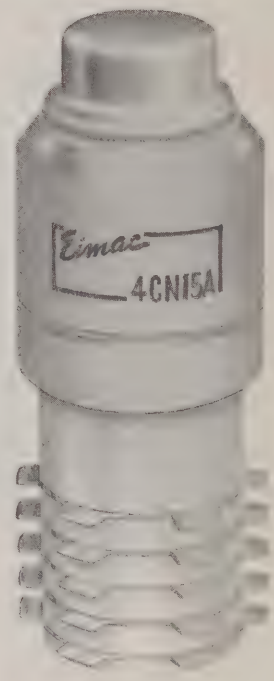



EIMAC 4-1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
300
200
100
0
-100
-200
0
1000
2000
3000
4000
5000
6000
7000
1.4
1.2
1.0
.800
.600
.500
.400
.300
.200
.100
.080
.070
.060
.050
.030
.020
.010
0
3.0
2.6
2.2
1.8
1.4
1.0
.600
.400
.200
.100
.030
0

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

4CN15A

CERAMIC POWER TETRODE



The Eimac 4CN15A is a coolerless version of the 4CX300A tetrode intended for use in low duty or pulse service. It is electrically identical to the 4CX300A with the exception of plate dissipation which is rated at 15 watts in air. Where other cooling means are used, such as liquid immersion, plate dissipation is limited only by the maximum allowable anode and seal temperatures.

GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-Coated, Unipotential				
	Heating Time	30	60		seconds
	Cathode-to-Heater Potential			±150	volts
Heater:	Voltage		6.0		volts
	Current	2.6		3.1	amperes
Amplification Factor (Grid to Screen)		4.0		5.6	
Transconductance (I_b = 200 ma)			12,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:					
	Input	25		33	uuf
	Output	3.5		4.5	uuf
	Feedback			0.06	uuf
Frequency for Maximum Ratings				500	Mc

MECHANICAL

Base	Special, breechblock terminal surfaces	
Recommended Socket	Eimac SK-700 series	
Operating Position	Any	
Maximum Operating Temperatures:		
	Ceramic-to-Metal Seals	250° C
	Anode Core	250° C
Cooling	Convection or conduction	
Maximum Over-all Dimensions:		
	Height	2.5 inches
	Diameter	inches
Net Weight		2.5 ounces
Shipping Weight		1 pound

MAXIMUM CW RATINGS

	Class-C FM or Teleg	Class-C Plate Mod	Class-AB		
DC PLATE VOLTAGE	2000	1500	2500*	MAX.	VOLTS
DC PLATE CURRENT	250	200	250	MAX.	MA
DC SCREEN VOLTAGE	300	300	400	MAX.	VOLTS
DC GRID VOLTAGE	-250	-250	---	MAX.	VOLTS
PLATE DISSIPATION	15**	10**	15**	MAX.	WATTS
SCREEN DISSIPATION	12	12	12	MAX.	WATTS
GRID DISSIPATION	2	2	2	MAX.	WATTS

*Up to 250 Mc.

**Rating in air - may be increased with adequate cooling.

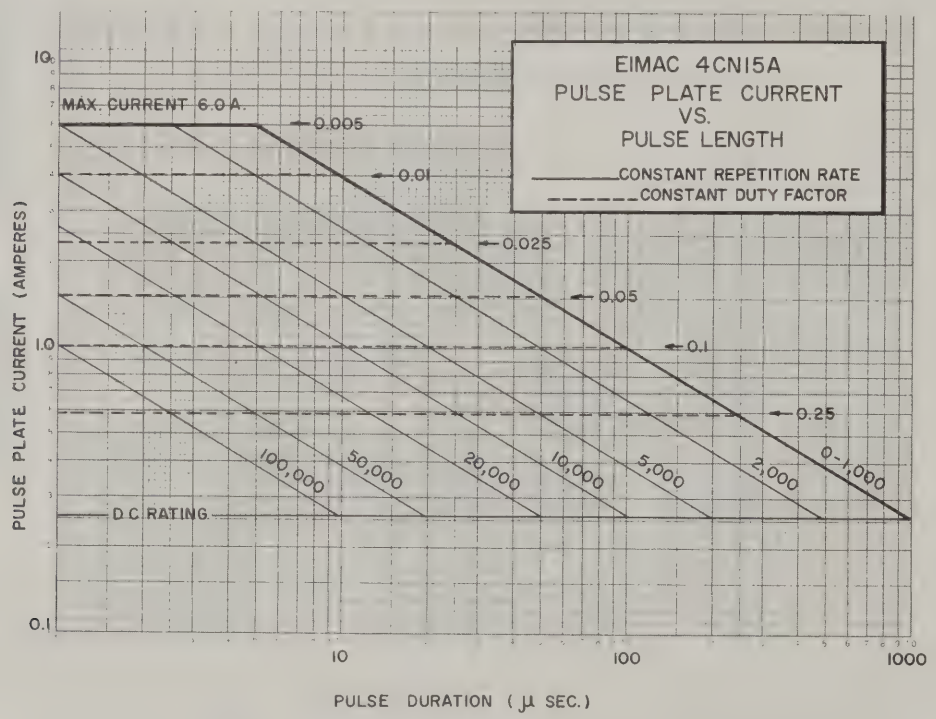
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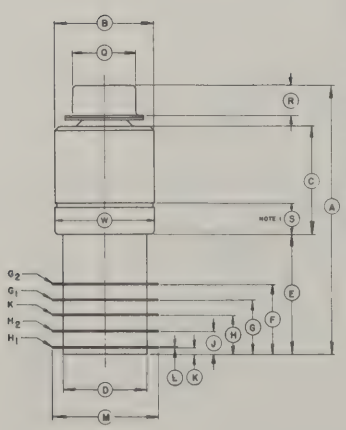
MAXIMUM PULSE RATINGS

	Class-C Grid Pulsed	Class-C Plate Pulsed	Pulse Modulator		
DC PLATE VOLTAGE	2500	7000 (pulsed)	4000	MAX.	VOLTS
PEAK PLATE CURRENT (DC Component)	6.0*	6.0*	6.0*	MAX.	AMPS
DC GRID VOLTAGE	-300	-500	-300	MAX.	VOLTS
DC SCREEN VOLTAGE	750	1500 (pulsed)	750	MAX.	VOLTS
PLATE DISSIPATION (AVG)**	15	15	15	MAX.	WATTS
SCREEN DISSIPATION (AVG)	12	12	12	MAX.	WATTS
GRID DISSIPATION (AVG)	2	2	2	MAX.	WATTS

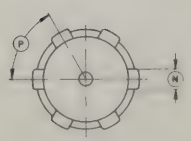
*According to table below.

**Depends on cooling method.





DIMENSION DATA			
REF	NOM	MIN	MAX
A		2.300	2.500
B		.880	.894
C		.941	.977
D		.740	.770
E		1.052	1.092
F		.602	.642
G		.470	.500
H		.329	.359
J		.193	.213
K		.050	.072
L		.010	.020
M		.936	.956
N		.170	.185
P	60°		
Q		.559	.573
R		.240	.280
S		.241	.313
W		.880	.920



NOTES
1. DO NOT CONTACT THIS SURFACE.
2. DIMENSIONS IN INCHES.

NOTE: These dimensions reflect standard manufacturing tolerances. Where they are to be made the basis of purchase specifications, they should first be checked with the factory.

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8590
4CPX250K

RADIAL BEAM TETRODE

The EIMAC 8590/4CPX250K is a compact forced-air cooled, external anode radial beam tetrode, intended for wideband grid-pulsed radio frequency amplifier and pulse modulator service.

The 8590/4CPX250K has a maximum anode dissipation of 250 watts and is capable of delivering pulse output power in excess of 10 kW with 10 db gain when cathode driven at 450 MHz.

The tube is of coaxial construction and especially designed for cavity operation.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	2.5	A
Amplification Factor (Average):		
Grid to Screen	5	
Direct Interelectrode Capacitances (Grounded grid)[2]		
Input	14.0	pF
Output	4.1	pF
Feedback	.006	pF
Frequency of Maximum Rating:		
CW	500	MHz
Plate or Grid-Pulsed	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:		
Length	2.81 in; 71.37	mm
Diameter	1.64 in; 41.66	mm
Net Weight	4 oz; 114	gm
Operating Position	Any	

(Effective 4-1-70) © 1970 by Varian Printed in U.S.A.

MECHANICAL

Maximum Operating Temperature:	
Ceramic/Metal Seals	250 °C
Anode Core	250 °C
Cooling	Forced-Air
Base	Coaxial
Socketing: EIMAC collets are available as follows:	
Heater pin connection	EIMAC Part No. 008290
Cathode connection	EIMAC Part No. 008291
Control grid connection	EIMAC Part No. 008292
Anode connection	EIMAC Part No. 008294
Screen grid connection	EIMAC Part No. 882931

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2500 VOLTS
DC SCREEN VOLTAGE	500 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.250 AMPERE
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

Plate Voltage	1000	1500	2000	2500	Vdc
Screen Voltage	250	250	250	250	Vdc
Grid Voltage	-90	-90	-90	-90	Vdc
Plate Current	250	250	250	250	mAdc
Screen Current [1]	38	21	19	16	mAdc
Grid Current [1]	31	28	26	25	mAdc
Peak rf Grid Voltage [1]	114	112	112	111	v
Calculated Driving Power [1]	3.5	3.2	2.9	2.8	W
Plate Input Power	250	375	500	625	W
Plate Output Power	190	280	390	500	W

1. Approximate value.

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC GRID VOLTAGE	-400 VOLTS
PEAK PLATE CURRENT	6.0 AMPERES
PULSE DURATION	(See Derating Chart)
DUTY FACTOR	(See Derating Chart)
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

Plate Voltage	6000 Vdc
Screen Voltage	750 Vdc
Grid Voltage	-275 Vdc
Peak Drive Voltage [1]	280 v
Peak Plate Current	3.5 a
Peak Screen Current [1]	0.4 a
Peak Input Power	21.0 kW
Peak Output Power	17.5 kW
Peak Output Voltage	5000 kv
Pulse Duration	250 μs
Duty Factor	0.005

1. Approximate value .

RF POWER AMPLIFIER

Class B or C, Grid and Screen Pulsed

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500	VOLTS
PEAK DC SCREEN VOLTAGE	1000	VOLTS
DC GRID VOLTAGE	-250	VOLTS
PEAK PLATE CURRENT [1]	6.0	AMPERES
PULSE DURATION	(See Derating Chart)	
DUTY FACTOR	(See Derating Chart)	
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Peak anode current may be considered as average during the pulse and should be limited to 6.0 amperes. With a pulse length longer than 80 μs, or a duty factor higher than 0.0016, peak current should be reduced in accordance with the data shown on the Derating Chart for Anode Current. For longer pulse duration or larger duty factor, consult EIMAC Division of Varian.

TYPICAL OPERATION (Frequencies to 500 MHz)
Class B, Grounded Grid (Measured Values)

Plate Voltage	5500	Vdc
Screen Voltage (Pulsed)	1000	v
Grid Voltage	-200	Vdc
Peak Grid Voltage [2]	255	v
Peak Driving Power [2]	1000	w
Peak Output Power (Useful)	10	kW
Pulse Duration	250	μs
Duty Factor	0.005	

2. Approximate value .

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	2.3	3.0	A
Cathode Warmup Time	30	---	sec.
Interelectrode Capacitances [1] (Grounded Grid Connection)			
Input	12.0	16.0	pF
Output	3.90	4.35	pF
Feedback	---	0.01	pF

1. Capacitance values are for a cold tube as measured in a shielded fixture.

APPLICATION

MOUNTING - The 8590/4CPX250K may be mounted in any position. The concentric arrangement of the electrode terminals permits the use of the tube in coaxial line or cavity-type circuits to advantage. Connections to the contact surfaces should be made by means of spring finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

HEATER - The rated heater voltage for the 8590/4CPX250K is 6.0 volts, as measured at the base of the tube, and variations should be restricted to plus or minus 0.3 volt for long tube life and consistent performance. At frequencies above approximately 300 MHz under Class C Telegraphy conditions, it may be necessary to reduce heater voltage to compensate for rf transit-time heating of the cathode. This type of back-heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. The following heater operation voltages are recommended for straight-through CW amplifier operation:

Frequency (MHz)	Heater Voltage
300 or lower	6.00
301 to 400	5.75
401 to 500	5.50

COOLING - Sufficient forced-air cooling must be provided to maintain the anode core and seal temperatures within maximum ratings. Special care must be observed to insure that there is adequate cooling in the area of the coaxial filament and grid terminals. With an anode dissipation of 250 watts and an incoming air temperature of 50°C at sea level, a minimum air flow of 4.8 cfm must be passed through the anode cooler, with a resultant pressure drop of approximately 0.25 inch of water. Air should normally be directed in a base-to-anode direction in order to minimize base cooling problems. In cases where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial. Air flow should be applied before or simultaneously with the application of electrode voltages (including heater voltage), and may be removed simultaneously with them.

CATHODE WARMUP TIME - Heater voltage should be applied for a minimum of 30 seconds before the application of other electrode voltages to allow proper conditioning of the cathode surface.

CATHODE OPERATION - The oxide-coated unipotential cathode must be protected against excessively high emission current. The DERATING CHART FOR ANODE CURRENT shows the current capability of the 8590/4CPX250K anode at various pulse durations and duty factors. To use this chart, enter with pulse duration and note the intersection with the desired peak anode current. At this intersection read off the values of maximum duty and/or pulse repetition rate.

Under a given set of operating conditions, element dissipation may limit the maximum permissible duty to a smaller value than anode current considerations alone would dictate. It will usually be found that screen grid dissipation is the limiting factor with large plate voltage swings and that plate dissipation limits the maximum duty with small plate voltage swings.

CONTROL GRID OPERATION - The average power dissipated by the control grid must not exceed two watts. The control grid dissipation can be computed as the product of average grid current, and peak positive grid to cathode voltage.

SCREEN GRID OPERATION - The average power dissipated by the screen grid must not exceed twelve watts. Screen grid dissipation is the product of dc screen voltage, average screen current during the pulse, and duty factor.

The screen grid current may reverse under certain operating conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen grid power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen grid under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator, or an electron tube shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per tube. A series pass tube regulated power supply can be used only when an adequate bleeder resistor is provided. Protection for the screen grid should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

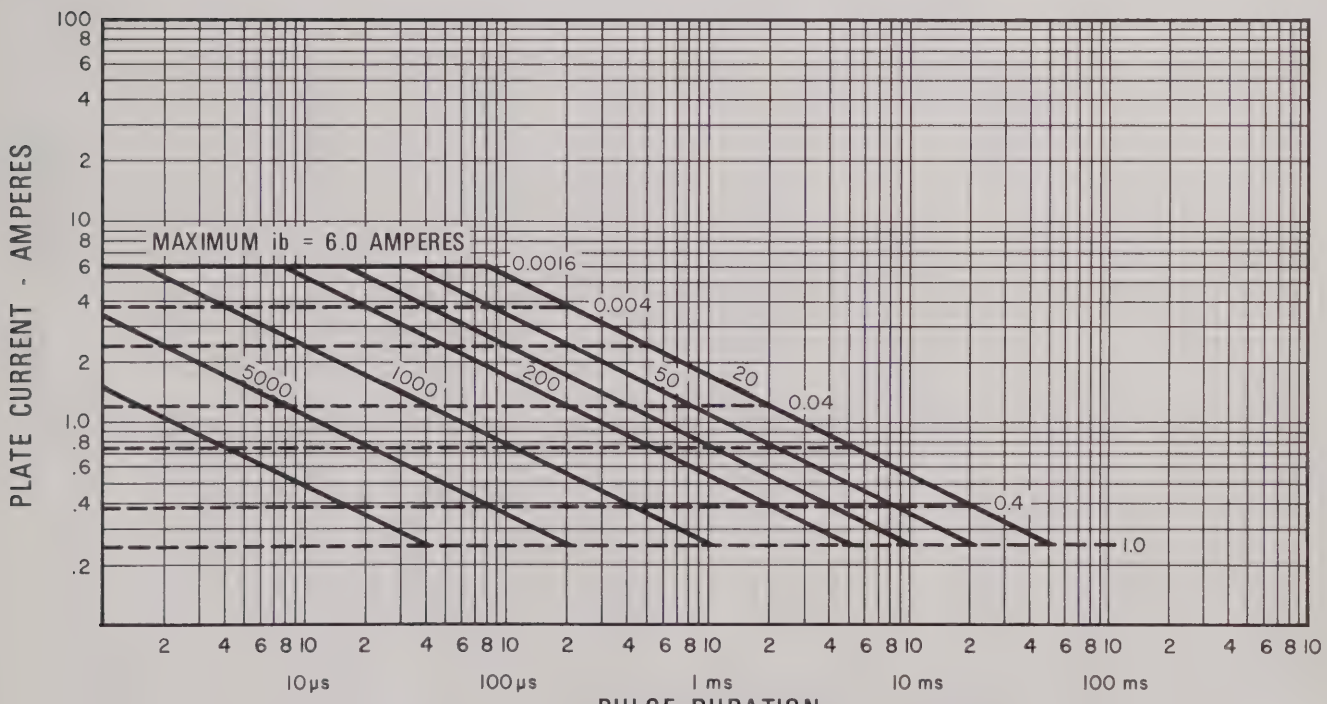
PULSE MODULATOR PLATE OPERATION - Average plate dissipation may be calculated as the product of average plate current during the pulse, minimum anode voltage, and duty factor. Excessive average dissipation is likely to occur with high values of minimum anode voltage. The calculated value of plate dissipation may well be below 250 watts based on a rectangular pulse but excessive dissipation will result if pulse rise and fall times slow down the plate voltage swing and allow plate current to flow for longer periods in the high anode voltage region.

UHF OPERATION - Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias and/or screen grid voltage to equalize the plate currents. Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that any tube fails.

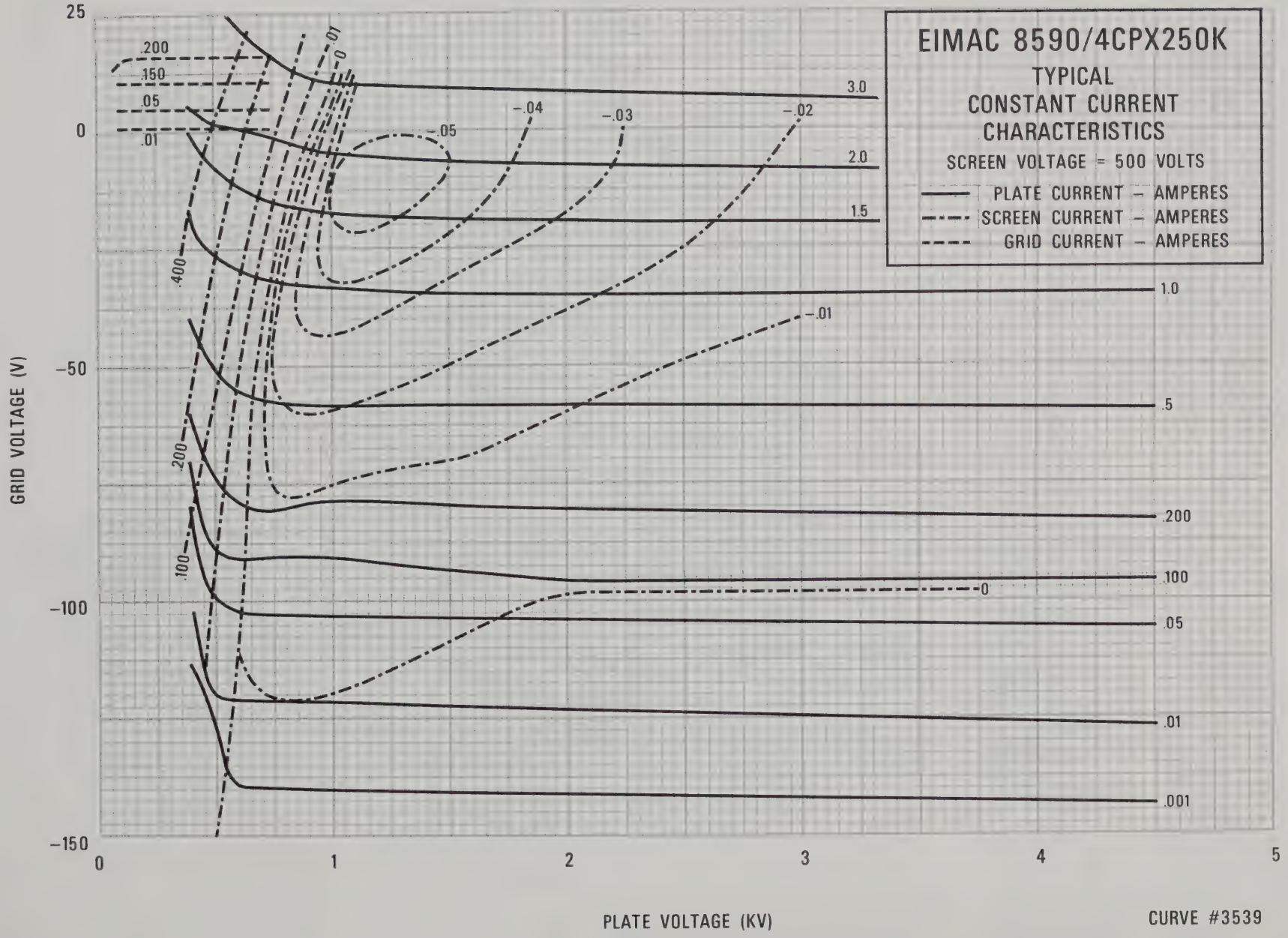
SPECIAL APPLICATION

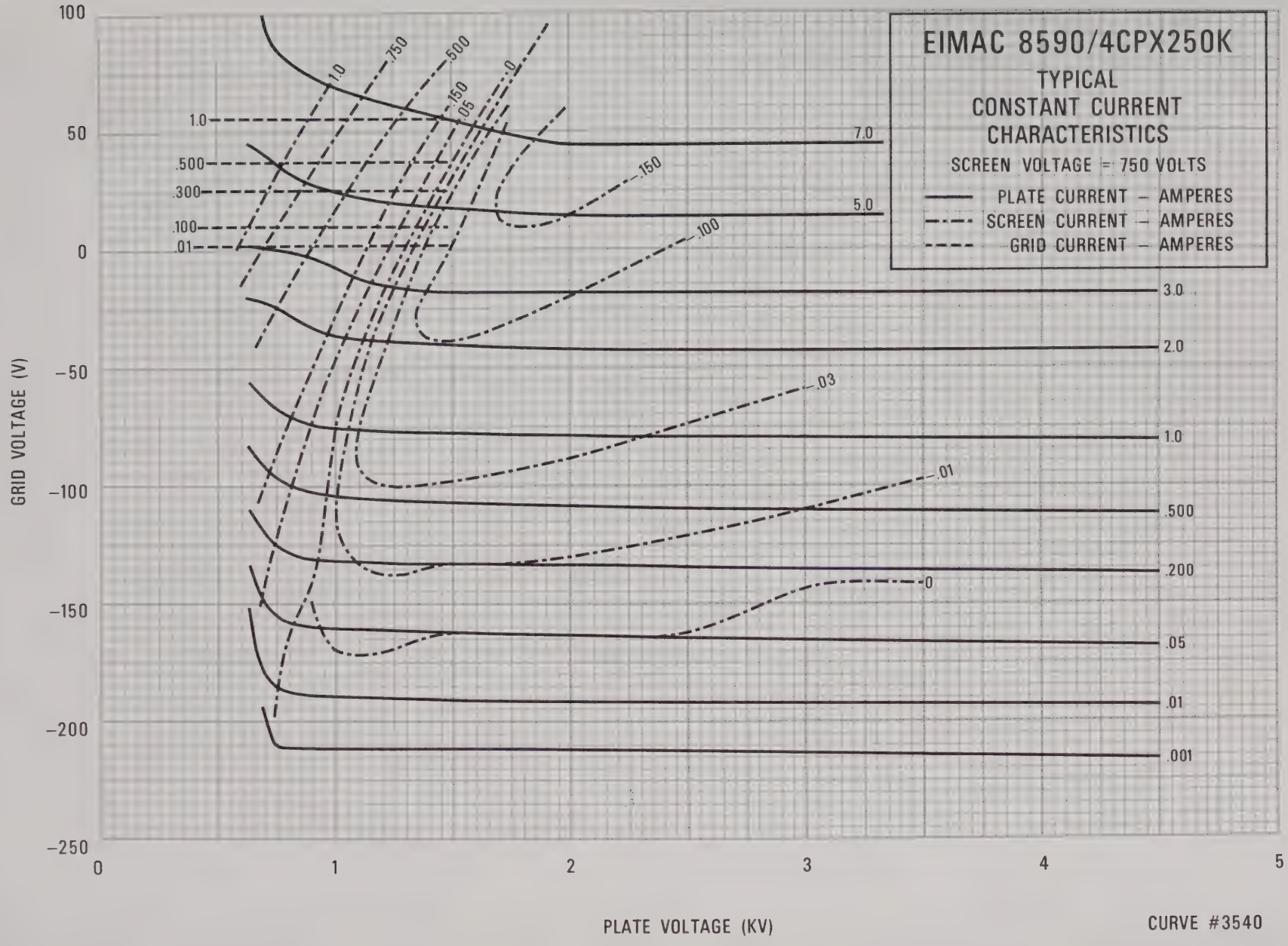
If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

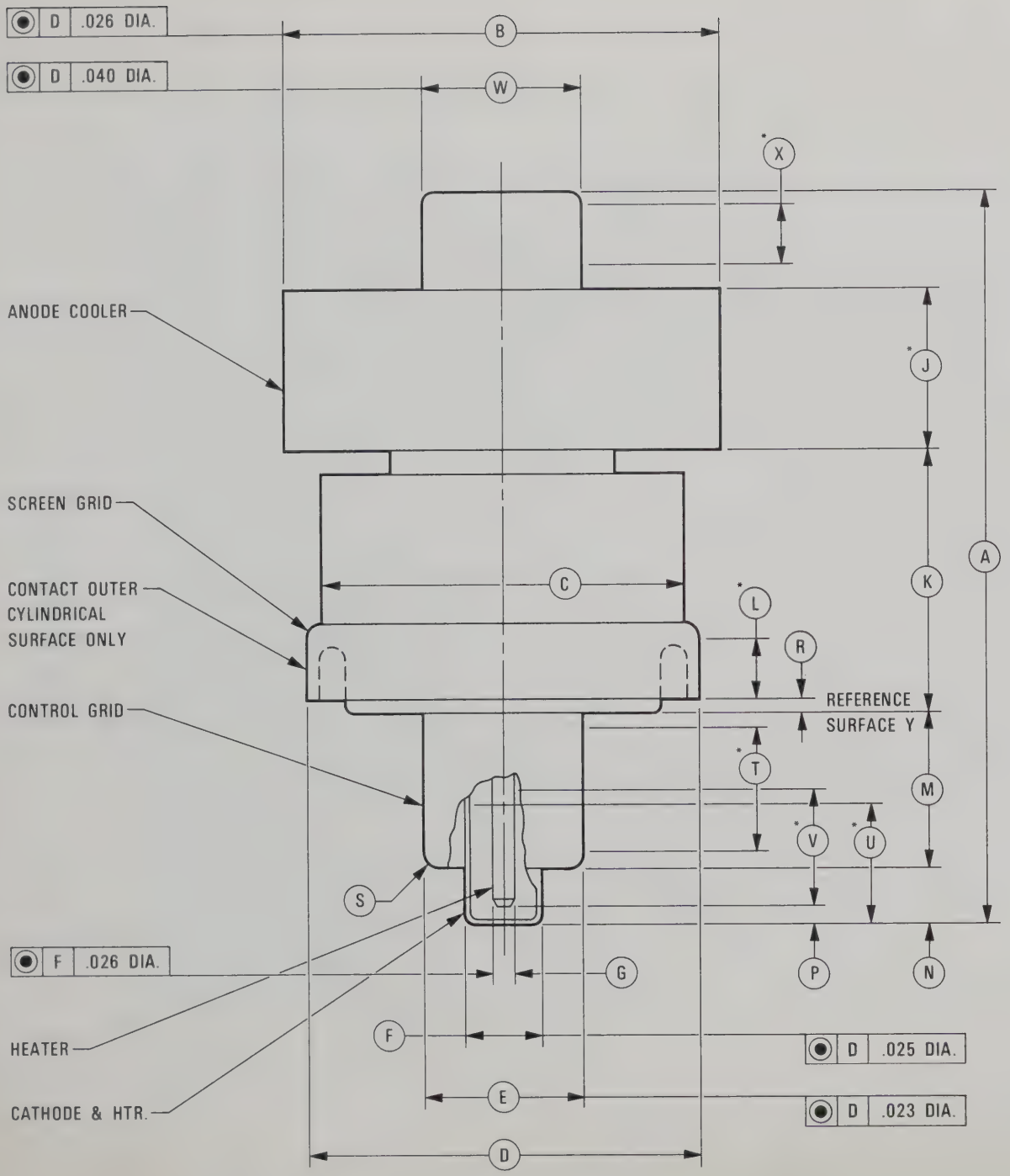


TYPE 8590/4CPX250K – DERATING CHART FOR ANODE CURRENT
(AVERAGE DURING PULSE)

SOLID LINES REPRESENT CONSTANT REPETITION RATES
DASHED LINES REPRESENT CONSTANT DUTIES
DO NOT EXTRAPOLATE ABOVE OR TO THE RIGHT OF BOLD LINES


EIMAC 8590/4CPX250K
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
CURVE #3539
25
0
–50
–100
–150
0
1
2
3
4
5
3.0
2.0
1.5
1.0
.5
.200
.100
.05
.01
.001
0
–.01
–.02
–.03
–.04
–.05
.200
.150
.05
.01
.400
.200
.100
.01
0


EIMAC 8590/4CPX250K
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
CURVE #3540
100
50
0
−50
−100
−150
−200
−250
0
1
2
3
4
5
7.0
5.0
3.0
2.0
1.0
.500
.200
.05
.01
.001
.03
.01
0
.100
.150
1.0
.500
.300
.100
.01
750
500
150
05
0



DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	—	2.813	—	71.45
B	1.615	1.640	41.02	41.66
C	—	1.406	—	35.71
D	1.415	1.435	35.94	36.45
E	0.588	0.597	14.94	15.16
F	0.318	0.325	8.08	8.26
G	0.091	0.095	2.31	2.41
J	0.585	0.665	14.86	16.89
K	0.900	0.950	22.86	24.13
L	0.187	—	4.75	—
M	0.520	0.560	13.21	14.22
N	0.235	0.265	5.97	6.73
P	0.032	0.082	0.83	2.08
R	—	0.040	—	0.102
S	—	0.171	—	0.434
T	0.388	—	9.86	—
U	0.406	—	10.31	—
V	0.468	—	11.89	—
W	0.559	0.573	14.20	14.55
X	0.240	—	6.10	—

NOTES:

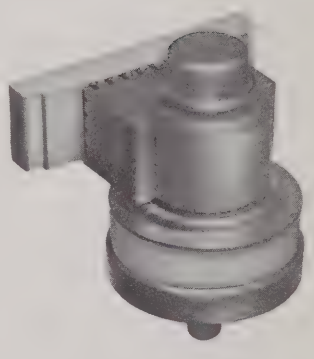
1. * INDICATES CONTACT SURFACE.
2. THE TUBE WILL BE ROTATED ON DIAMETER D WHEN ECCENTRICITY IS BEING MEASURED.
3. SURFACE Y MUST BE PERPENDICULAR TO THE MEASURING PLATFORM WHEN ECCENTRICITY IS BEING MEASURED.
4. AVERAGE DIAMETER OF E SHALL BE AS NOTED, & MAY BE OUT OF ROUND A TOTAL OF 0.006 (0.15 mm). AVERAGE DIAMETER OF F SHALL BE AS NOTED, AND MAY BE OUT OF ROUND A TOTAL OF 0.006 (0.15 mm).

4CS250R

TECHNICAL DATA

CONDUCTION COOLED
RADIAL BEAM
TETRODE

The 4CS250R is a compact, conduction cooled, high perveance radial beam tetrode. It is electrically identical to the 4CX250R except that the maximum dissipation of the 4CS250R is limited only by the maximum allowable anode and ceramic/metal seal temperatures. A beryllium oxide (BeO) thermal link is brazed to the anode providing an electrically isolated, low thermal resistance path between the anode and the heat sink. Ruggedized construction allows the 4CS250R to be operated in applications where shock and/or vibration is experienced.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	2.6 A
Cathode - Heater Potential	±150 V
Direct Interelectrode Capacitances (grounded cathode)[2]	
Input	17 pF
Output [3]	4.7 pF
Feedback	0.04 pF
Frequency of Maximum Rating:	
CW	500 MHz
Plate or Grid-Pulsed	500 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. In Shielded Fixture.
3. See output capacitance.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.46 in; 62.5 mm
Diameter	1.76 in; 44.9 mm
Net Weight	5 oz; 141.7 gm
Operating Position	Any

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Maximum Operating Temperature:

Ceramic/Metal Seals	250°C
Anode Core	250°C
Plate and Base Seals	250°C
Cooling	Conduction
Base	Special 9-pin
Recommended Socket	EIMAC SK-660, SK-661 series

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN CATHODE DRIVEN
Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	500	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.250	AMPERE
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 500 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1500	2000	Vdc
Screen Voltage	350	400	Vdc
Grid Voltage [1]	-62	-80	Vdc
Zero-Signal Plate Current	133	70	mAdc
Two-Tone Plate Current	250	245	mAdc
Two-Tone Screen Current [2]	-10	+1	mAdc
Peak rf Grid Voltage	56	80	v
Useful Output Power	262	470	w
Resonant Load Impedance	2160	2840	Ω
Intermodulation Distortion Products [3]			
3rd Order	-30	-23	db
5th Order	-35	-27	db

1. Adjust to specified zero-signal dc plate current.
2. Approximate values.
3. The intermodulation distortion products are referenced against one tone of a two equal tone signal.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.250	AMPERE
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-90	-90	-90	Vdc
Plate Current	227	240	241	mAdc
Screen Current [1]	9	8	8	mAdc
Grid Current [1]	11	10.5	10.5	mAdc
Peak rf Grid Voltage [1]	104	104	104	v
Calculated Driving Power [1]	1.2	1.1	1.1	W
Plate Input Power	170	360	482	W
Plate Dissipation	17	91	103	W
Plate Output Power	153	269	379	W
Resonant Load Impedance	1833	2900	4041	Ω

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN
Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	1500	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.200	AMPERE
SCREEN DISSIPATION [1]	12	WATTS
GRID DISSIPATION [1]	2	WATTS

1. Average, with or without modulation.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB_1, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	500	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.250	AMPERE
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Two Tubes) (Push-Pull)

Plate Voltage	1500	2000	Vdc
Screen Voltage	300	350	Vdc
Grid Voltage 1/2.	-48	-66	Vdc
Zero-Signal Plate Current	200	140	mAdc
Max. Signal Plate Current	490	500	mAdc
Zero-Signal Screen Current[1]	-2	-4	mAdc
Max. Signal Screen Current[1]	0	+4	mAdc
Plate Output Power	390	595	W
Load Resistance (plate to plate)	5920	8016	Ω

1. Approximate value.
2. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	2.3	2.9	A
Cathode Warmup Time	30	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Input	16.0	18.5	pF
Output	4.2	5.2	pF
Feedback	---	0.06	pF

1. In Shielded Fixture.

APPLICATION

MECHANICAL

MOUNTING & SOCKETING - The 4CS250R may be mounted in any position. EIMAC SK-660 and SK-661 socket series is recommended. The SK-660 (made of alumina) and the SK-661 (made of BeO) will allow the tube base seal heat to be effectively transferred to the heat sink. Other sockets may be used if a means for keeping the ceramic/metal base seals below 250°C is provided. The EIMAC SK-655 and ERIE 2943 and 2929 series screen by-pass capacitor are recommended for use with the 4CS250R. Figure 1 shows the recommended method of mounting the 4CS-250R to the heat sink.

When using natural convection heat sinks, Figure 2 will assist the designer in determining the minimum heat sink surface area required for the given power dissipation. The thermal and electrical characteristics of the BeO used on the 4CS250R are given in Table I and Figure 3.

A good thermally conductive compound (1) should be used in the interface to reduce the thermal resistance of this joint. In addition, the method of fastening the tube to the heat sink should provide reasonable compression to help further reduce this interface thermal resistance.

The effectiveness of any cooling system used with the 4CS250R is determined by the anode and ceramic/metal seal temperatures. These must be held below 250°C for all conditions of expected ambient temperatures and operation. These temperature parameters should be measured in the design stage using accurate thermocouples or thermistors.

(1) Thermal joint compound and supplier.

a) Wakefield 120, Wakefield Engineering Co. Wakefield, Mass.
b) Dow Corning 340, Dow Corning Corp., Midland, Michigan.
c) Astrodyne Thermal Bond 312, Astrodyne, Inc., Burlington, Mass.
d) General Electric Insulgrease – G641, General Electric Co. Cleveland Ohio, 44117.

COOLING - The 4CS250R is designed for conduction cooled systems by using a beryllium oxide (BeO) thermal link brazed to the anode. The BeO is a ceramic material which exhibits high thermal conductance similar to aluminum and high electrical resistance and low loss typical of ceramics. When this BeO thermal link is fastened to a suitable heat sink, it provides a low thermal resistance path allowing the anode heat to be transferred to the heat sink. The BeO also provides electrical isolation between the tube anode and the heat sink.

The heat sink can be cooled by natural (free) convection, forced air convection, liquid cooling or a combination of these methods. The design choice is determined by the tubes application but in all cases the cooling system must maintain the anode and ceramic/metal seal temperatures below 250°C.

In a conduction cooled system, anode temperature and seal temperature are determined by the thermal resistance of the thermal path between the anode and the cooling medium, e.g., air, water. The thermal path consists of the Beryllium oxide thermal link, the interface between the thermal link and heat sink, and the heat sink. The thermal resistance of the BeO thermal link versus its average temperature is given in Figure 3. The tube user must then determine the thermal resistance of the thermal link from the BeO thermal link to the cooling medium for his particular application.

DANGER-BERYLLIUM OXIDE CERAMICS (BeO) BREATHING DUST OR FUMES CAN KILL
Normal use of tubes with Beryllium Oxide ceramics is not hazardous, but the user is cautioned that breathing small quantities of the dust or fumes from Beryllium Oxide can seriously injure or kill. Do not alter, disassemble, grind, lap, fire, chemically clean, or perform any other operation on the Beryllium Oxide block attached to the anode of the 4CS250R, or to the socket used with the tube, which may also contain Beryllium Oxide.

Any tube or accessory part containing Beryllium Oxide ceramics should be returned to EIMAC at the end of its useful life, with authorization for disposal.

SHOCK AND VIBRATION - The 4CS250R is shock and vibration tested with plate and screen voltages applied. Production tubes are randomly sampled and tested under the following conditions.

With a plate voltage of 2000 volts applied, the tubes sampled are subjected to six shocks of 90 G's minimum half-sine-wave motion, with a duration of 11.0 ± 2 milliseconds, in each of the three major axes (X, Y, Z).

With the rated plate and screen voltages applied and the control grid voltage adjusted for a plate current of 100 ma. through a plate load resistance of 4900 ohms, each of the tubes tested is vibrated in the three major axes throughout the range of 28 to 2000 and back to 28 Hz in a

CHARACTERISTICS OF 99.5% BeO

Electrical Resistivity in ohm-cm @250°F	10^{14}	Dielectric Strength in volts/mil	300
Dielectric Constant at 70°F and 1 MHz at 70°F and 8.5 GHz at 250°F and 8.5 GHz	 6.40 6.57 6.64	Thermal Conductivity (K) in Cal./Cm²/Cm/Sec./°C of 99.5% BeO	
		20°C 100°C 400°C	0.60 0.45 0.20
Loss Tangent at 70°F and 1 MHz at 70°F and 8.5 GHz at 250°F and 8.5 GHz	 0.0006 0.00044 0.00040	(From Coors Data Sheet 0001, Aug 1965)	

Table I

minimum time of six minutes per axis. The vibration level is maintained at 10 G's. The noise voltage developed across the plate load resistor may not exceed 30 volts rms.

VOLTAGE BREAKDOWN VERSUS ALTITUDE - Table II shows typical breakdown voltage versus altitude across the BeO thermal link. The measurements were taken with the heat sink plate at ground potential and the anode at the breakdown potential.

Altitude (thousands of feet)	All voltage readings in kVdc (typical)
Sea Level	11.5
5	10.5
10	10.5
15	9.0
20	7.5
25	6.5
30	5.5
35	5.0
40	4.0
45	4.0
50	3.5

Table II

OUTPUT CAPACITANCE - The interelectrode capacitances given in the General Characteristics are measured in a shielded fixture and does not include additional external capacitances. The typical capacitance between the anode and a heat sink plate 4'' x 4'' is 6.7 pF at 25°C. Total output capacitance will be approximately 11.5 pF. The measurement configuration is shown in Figure 1.



FIG. 1 TYPICAL MOUNTING CONFIGURATION

ELECTRICAL

HEATER/CATHODE OPERATION - For maximum life and uniform performance, the heater voltage should be maintained within plus or minus 5% of the rated 6.0 volts at operating frequencies up to 300 MHz for CW use. Between 300 and 400 MHz, 5.75 volts is recommended and between 400 and 500 MHz 5.5 volts is recommended.

GRID OPERATION - Maximum rated dc bias voltage is -250 volts. D.C. resistance, grid to cathode, should be no more than 100,000 ohms. Maximum grid dissipation allowable is 2 watts.

SCREEN OPERATION - Maximum screen dissipation is 12 watts, normally computed by multiplying dc screen voltage by the average screen current. This computation is essentially correct except in the case of heavy plate loading when secondary emission current may mask the normal screen current.

All tetrodes, under some conditions of loading and drive, will exhibit secondary emission from the screen which changes the net current to the screen and may even cause the screen meter to reverse. Normally, secondary emission is harmless provided the screen voltage is stable. To insure stable screen voltage, it is recommended that a bleeder resistor calculated to pass 15 ma from screen to ground be used.

PLATE OPERATION - The plate dissipation rating of the 4CS250R is limited by anode core and ceramic/metal seal temperature. These are a function of the thermal link and are discussed in the "Cooling" section.

MULTIPLE OPERATION - To obtain maximum power with minimum distortion from tubes operated in multiple it is desirable to adjust individual screen or grid-bias voltages so the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual dc plate currents will be approximately equal for full input signal for class-AB1 operation.

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

ANODE POWER DISSIPATION OF 4CS250R VS HEAT SINK AREA FOR WAKEFIELD B–1703 (SAFETY FACTOR INCLUDED)

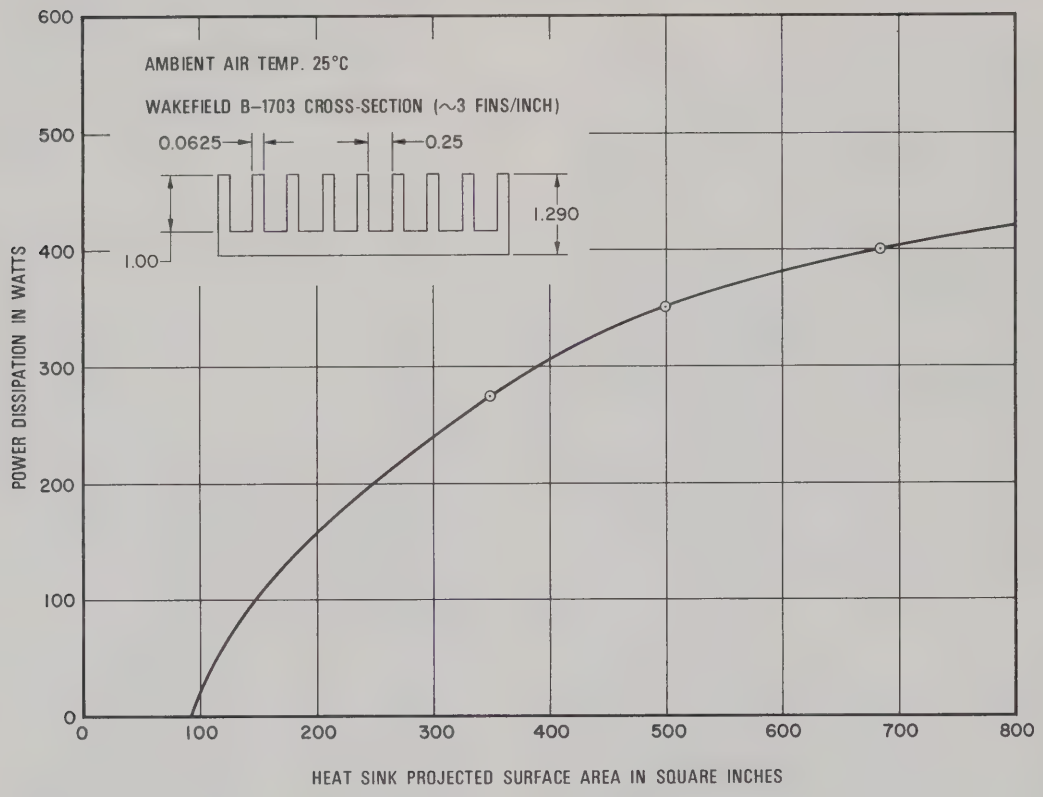


FIG. 2

THERMAL RESISTANCE VS AVERAGE TEMPERATURE OF 4CS250R THERMAL LINK INCLUDING 1 LAYER OF WAKEFIELD 120 THERMAL COMPOUND BETWEEN B_EO AND HEAT SINK

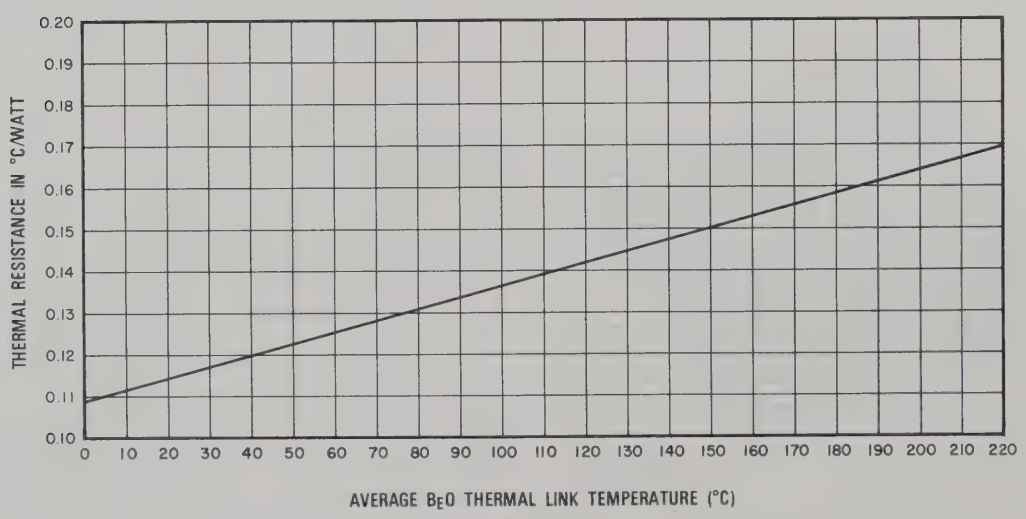
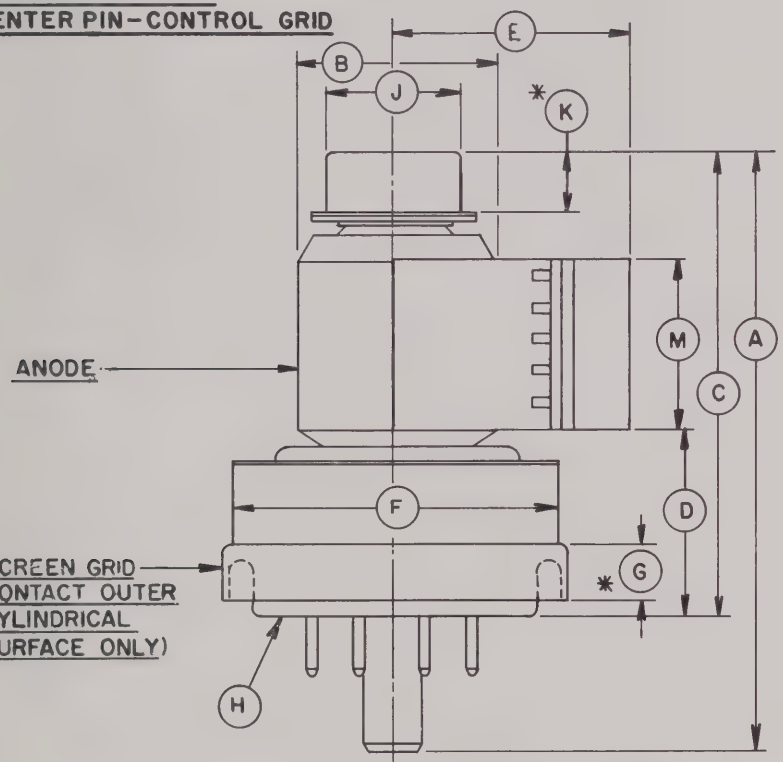
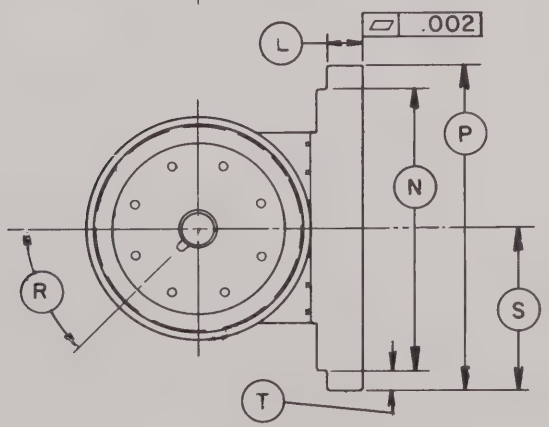
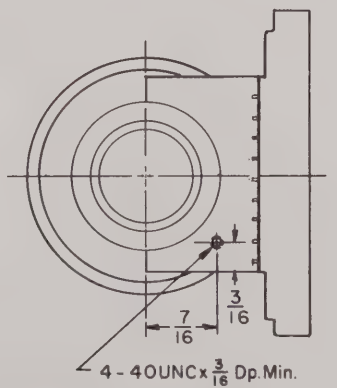


FIG. 3

PIN NO. 1. SCREEN GRID
PIN NO 2 CATHODE
PIN NO. 3. HEATER
PIN NO. 4. CATHODE
PIN NO 5. I.C DO NOT USE FOR EXTERNAL CONNECTION
PIN NO. 6. CATHODE
PIN NO. 7. HEATER
PIN NO. 8. CATHODE
CENTER PIN – CONTROL GRID





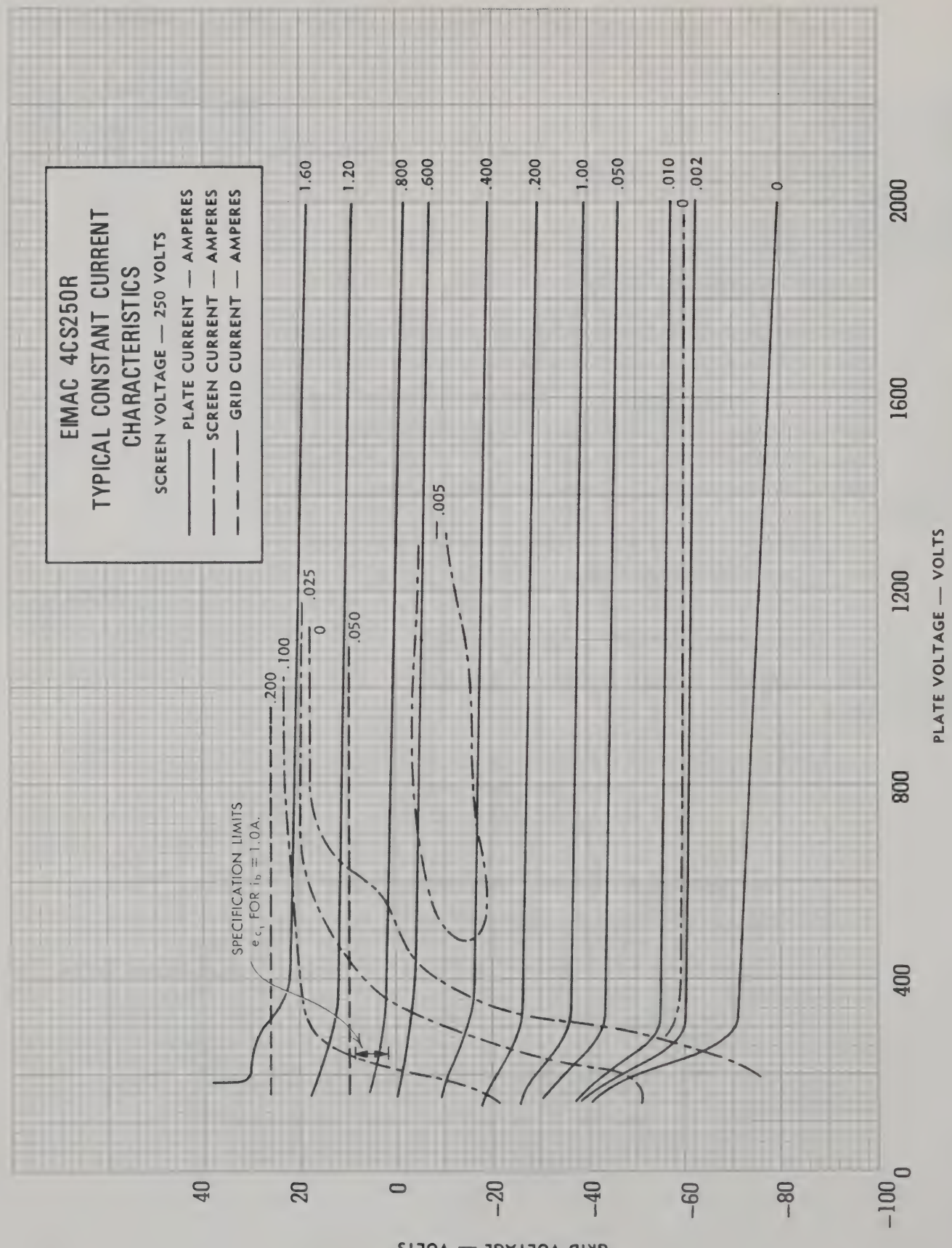


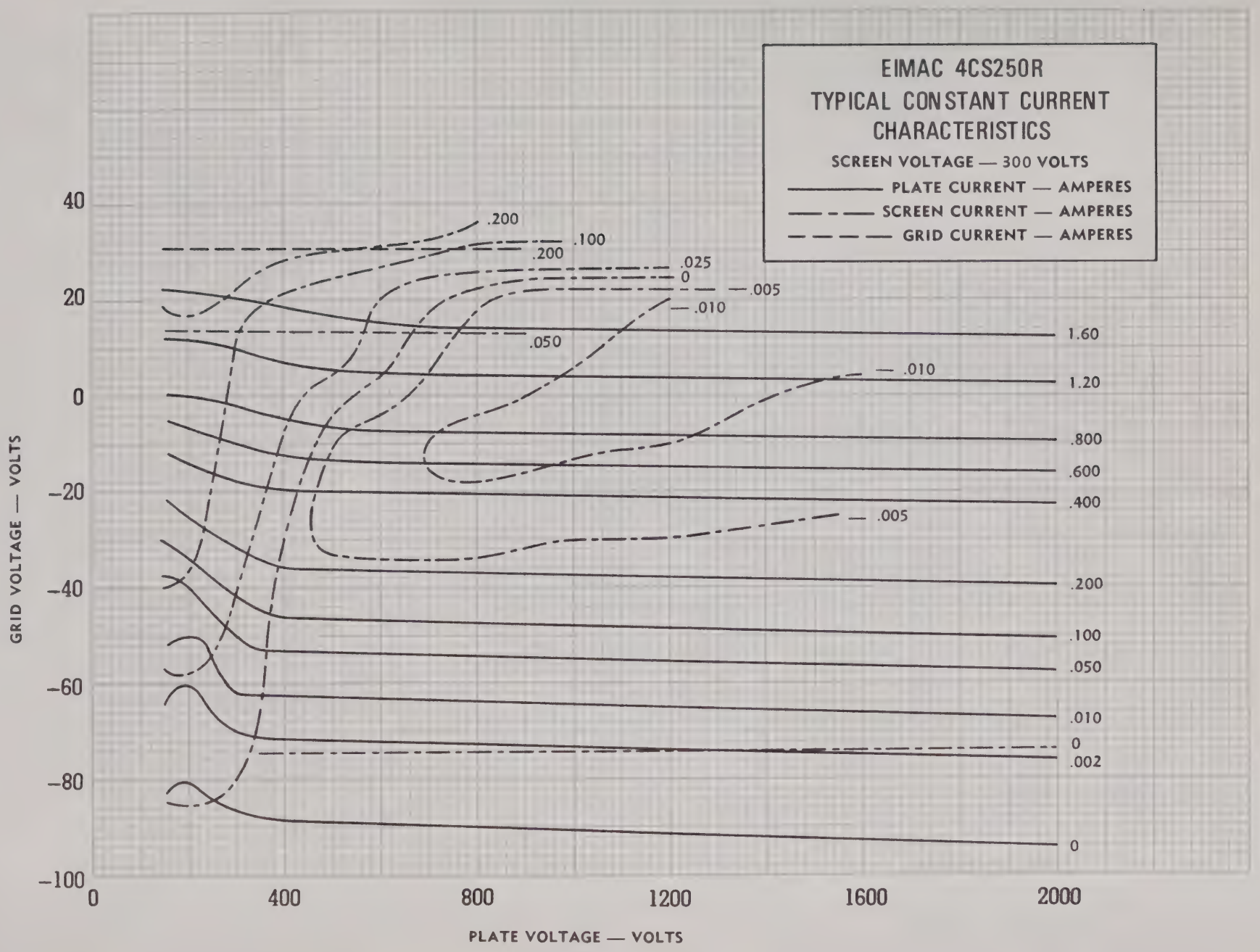
TOP VIEW

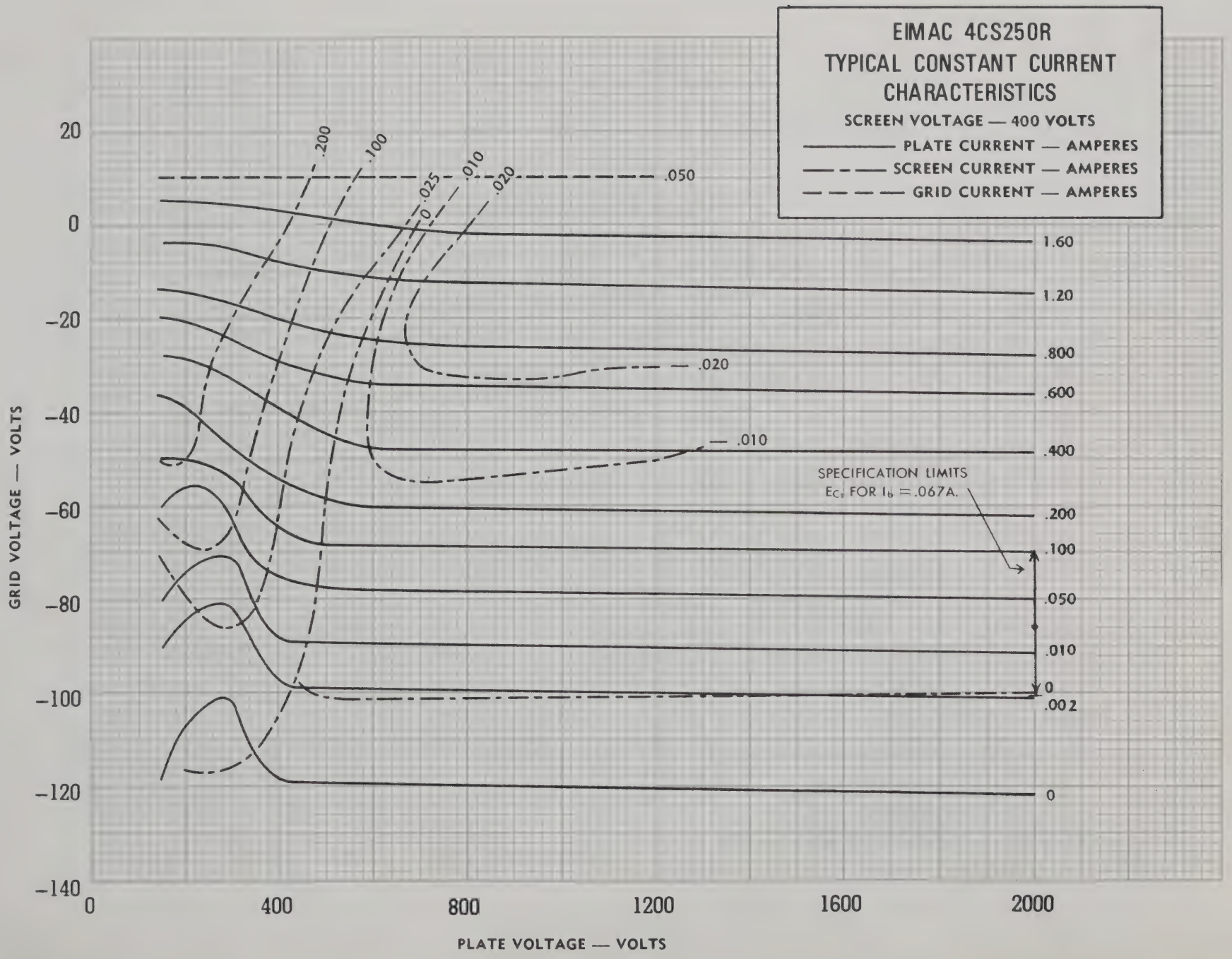
DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX	REF.	MIN.	MAX.	REF
A	2.324	2.464	- -	59.03	62.59	- -
B	0.880	0.894	- -	22.35	22.71	- -
C	1.810	1.910	- -	45.97	48.51	- -
D	0.760	0.800	- -	19.30	20.32	- -
E	0.985	1.015	- -	25.02	25.78	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE B8-236 (JEDEC DESIGNATION)					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240	- -	- -	6.10	- -	- -
L	0.214	0.228	- -	5.44	5.79	- -
M	0.600	0.640	- -	15.24	16.26	- -
N	1.733	1.767	- -	44.02	44.88	- -
P	19.80	20.30	- -	50.29	51.56	- -
R	43°	47°	- -	43°	47°	- -
S	0.985	1.105	- -	25.02	25.78	- -
T	0.107	0.143	- -	2.72	3.63	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.


EIMAC 4CS250R
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
1.60
1.20
.800
.600
.400
.200
1.00
.050
.010
.002
0
.005
.025
.050
.100
.200
SPECIFICATION LIMITS
e_{c_1} FOR i_b = 1.0A.
GRID VOLTAGE — VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
PLATE VOLTAGE — VOLTS


EIMAC 4CS250R
TYPICAL CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 300 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
.200
.100
.200
.025
0
.005
.010
.050
.010
1.60
1.20
.800
.600
.400
.005
.200
.100
.050
.010
0
.002
0


EIMAC 4CS250R
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 400 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
20
0
-20
-40
-60
-80
-100
-120
-140
0
400
800
1200
1600
2000
.200
.100
.050
.025
.010
.020
0
1.60
1.20
.800
.600
.400
.200
.100
.050
.010
0
.002
SPECIFICATION LIMITS
Ec1 FOR Ib = .067A.

4CV8000A

TECHNICAL DATA

VAPOR-COOLED
RADIAL-BEAM
POWER-TETRODE

The EIMAC 4CV8000A is a ceramic/metal vapor-cooled power tetrode designed to be used as a Class-AB1 linear amplifier in audio or radio-frequency applications. Its characteristic of low intermodulation distortion makes it specially suitable for single-sideband service. The vapor-cooled anode has a dissipation rating of 8000 watts when mounted in an EIMAC BR-101 broiler.

The 4CV8000A is also recommended for Class-C radio-frequency power amplifier and plate-modulated radio-frequency power amplifier service.



GENERAL CHARACTERISTICS[1]

Filament: Thoriated Tungsten	
Voltage	9.0 ± 0.45 V
Current, at 9.0 volts	41.5 A
Amplification Factor (Average):	
Grid to Screen	5.5
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	130 pF
Cout	12.5 pF
Cpk	1.0 pF
Frequency of Maximum Rating:	
CW	150 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accorcance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	7.98 in; 202.69 mm
Diameter	7.87 in; 199.90 mm
Net Weight	7.0 lb; 3.2 kg
Operating Position	Axis vertical, base up
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Flange	110°C
Cooling	Vapor and Forced Air
Base	Special, ring and breach-block terminal surfaces
Recommended Air System Socket	SK-1490
Recommended Boiler	BR-101

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Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, Class AB1

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC SCREEN VOLTAGE	1000	VOLTS
DC PLATE CURRENT	2.0	AMPERES
PLATE DISSIPATION	8000	WATTS
SCREEN DISSIPATION	175	WATTS
GRID DISSIPATION	50	WATTS

1. Adjust to specified zero-signal dc plate current.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions.

Plate Voltage	5000	6000	Vdc
Screen Voltage	850	850	Vdc
Grid Voltage [1]	-130	-135	Vdc
Zero-Signal Plate Current	1.0	1.0	Adc
Single-Tone Plate Current	1.95	2.0	Adc
Single-Tone Screen Current [2]	130	125	mAdc
Peak rf Grid Voltage [2]	120	125	v
Plate Dissipation	3650	4750	W
Plate Output Power	6000	7250	W
Resonant Load Impedance	2170	1825	Ω

2. Approximate value .

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	7000	VOLTS
DC SCREEN VOLTAGE	1000	VOLTS
DC PLATE CURRENT	2.0	AMPERES
PLATE DISSIPATION	8000	WATTS
SCREEN DISSIPATION	175	WATTS
GRID DISSIPATION	50	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	6000	7000	Vdc
Screen Voltage	500	500	Vdc
Grid Voltage	-240	-265	Vdc
Plate Current	1.95	1.90	Adc
Screen Current [1]	315	295	mAdc
Grid Current [1]	135	125	mAdc
Peak rf Grid Voltage [1]	345	370	v
Calculated Driving Power	47	47	W
Plate Output Power	9.2	11.0	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC SCREEN VOLTAGE	600	VOLTS
DC PLATE CURRENT	1.4	AMPERES
PLATE DISSIPATION [1]	5500	WATTS
SCREEN DISSIPATION [2]	175	WATTS
GRID DISSIPATION [2]	50	WATTS

1. Corresponds to 8000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	4000	5000	Vdc
Screen Voltage	400	400	Vdc
Grid Voltage	-250	-250	Vdc
Plate Current	1.4	1.35	Adc
Screen Current [1]	225	235	mAdc
Grid Current [1]	115	125	mAdc
Peak af Screen Voltage [1] (100% modulation)	365	365	v
Peak rf Grid Voltage [1]	335	330	v
Calculated Driving Power	39	42	W
Plate Dissipation	1200	1250	W
Plate Output Power	4400	5500	W

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB , Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	7000	VOLTS
DC SCREEN VOLTAGE	1000	VOLTS
DC PLATE CURRENT	2.0	AMPERES
PLATE DISSIPATION	8000	WATTS
SCREEN DISSIPATION	175	WATTS
GRID DISSIPATION	50	WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	5000	6000	Vdc
Screen Voltage	850	850	Vdc
Grid Voltage [1/3]	-130	-135	Vdc
Zero-Signal Plate Current	2.0	2.0	Adc
Max. Signal Plate Current	3.9	4.0	Adc
Max. Signal Screen Current[1]	260	250	mAdc
Peak af Grid Voltage[2]	120	125	v
Max. Signal Plate Dissipation[2]	3650	4750	W
Plate Output Power	12.0	14.5	kW
Load Resistance (plate to plate)	4340	3650	Ω

1. Approximate value.
2. Per Tube.
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In Class C service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 9.0 volts	39.5	43.5	A
Interelectrode Capacitances[1] (grounded cathode connection)			
Cin	120	140	pF
Cout	10.5	14.5	pF
Cgp	---	1.4	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CV8000A must be operated with its axis vertical, base up in an EIMAC BR-101 boiler. Care must be exercised when installing to insure that the boiler is level, the water is at the proper level and that the flange of the tube makes a vapor tight seal against the rubber "0" ring and boiler. A typical vapor cooling system is shown in this data sheet.

SOCKET - The EIMAC SK-1490 socket is available for use with the 4CV8000A. Filament, control-grid, and screen-grid connections are made to this socket.

COOLING - Cooling is accomplished by immersing the anode in the distilled water filled BR-101 boiler. The energy dissipated at the anode causes the water to boil at the surfaces of the anode, be converted into steam and be carried away to the condenser. The boiling action keeps the anode surfaces at approximately 100°C. In a properly designed boiler-tube system (such as the 4CV8000A and BR-101), it is extremely unlikely that the anode surfaces will ever exceed 110°C - well below the 250°C maximum rating - at full dissipation ratings.

The water in the boiler must be maintained at

a constant level, just below the top of the fins on the anode cooler. This is accomplished automatically in the vapor cooling system shown. Condensate from the condenser is returned to the boiler to maintain this constant fluid level. Any decrease in liquid level is sensed by the control box, CB-102. A low water level in the control box activates the solenoid water valve, allowing make-up water from the reservoir to enter the boiler. When the proper level is reached, the control box de-energizes the solenoid, stopping the flow from the reservoir. A second switch in the control box is energized if the water level drops to a lower level because of an empty reservoir or a constriction in the line. This switch may be used to shut down the equipment or activate an alarm.

For reliable operation, it is important that the control box and boiler be mounted so that the level sensed by the control box is exactly the same as the level in the boiler.

Cooling of the tube base is accomplished by blowing 25-50 CFM of air through the socket from the sides.

ELECTRICAL

HIGH VOLTAGE - Normal operating voltages used with the 4CV8000A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

FILAMENT OPERATION - The rated filament voltage for the 4CV8000A is 9.0 volts. Filament voltage, as measured at the socket, must be maintained at 9.0 volts plus or minus five percent to obtain maximum tube life. The use of a constant voltage filament transformer is recommended.

GRID OPERATION - The 4CV8000A grid has a maximum dissipation rating of 50 watts. Precautions should be observed to avoid exceeding this rating. Grid dissipation is the product of the dc grid current and the peak positive grid voltage swing.

SCREEN OPERATION - The power dissipated by the screen must not exceed 175 watts. Screen dissipation, in cases where no ac is applied to the screen, is the product of screen voltage and screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power and screen voltage.

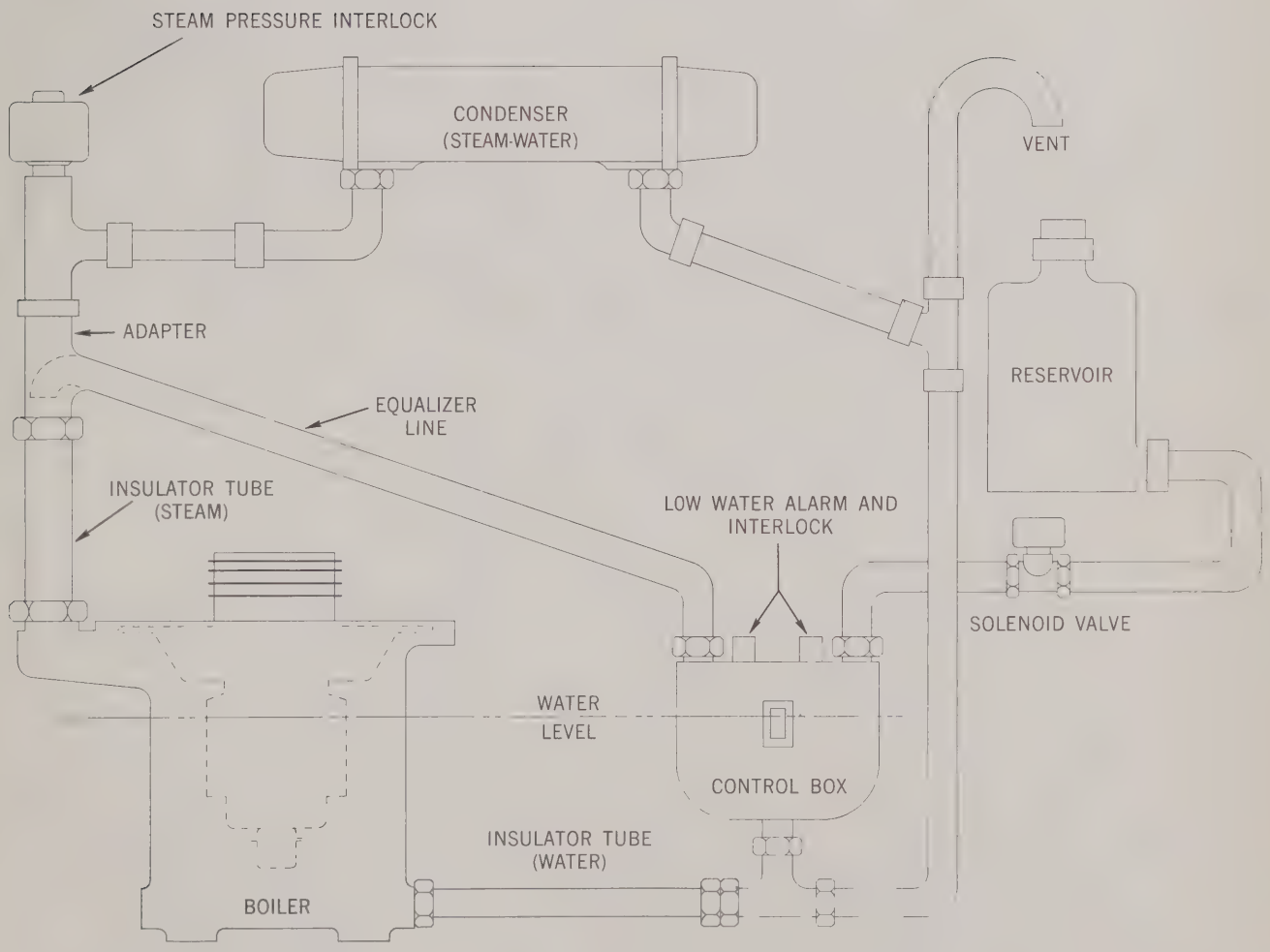
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation in the event of these failures.

PLATE DISSIPATION - The plate dissipation rating of 8000 watts attainable through vapor cooling provides a large margin of safety. It is unlikely that this rating will be exceeded, even during tuning periods.

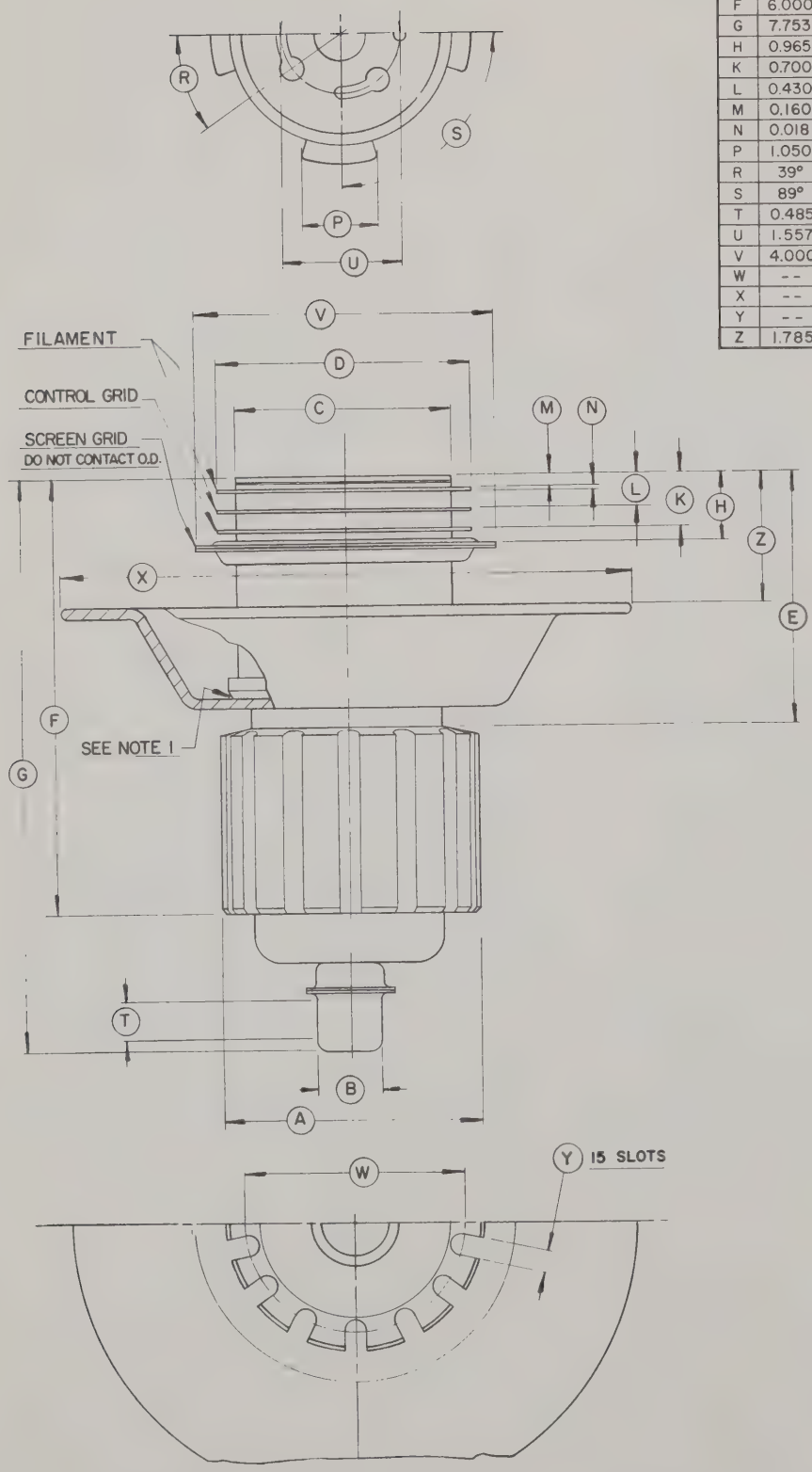
When the 4CV8000A is used as a plate-modulated rf amplifier, this rating is reduced to 5500 watts with a reduced plate input rating of 5000 volts and 1.4 amps.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

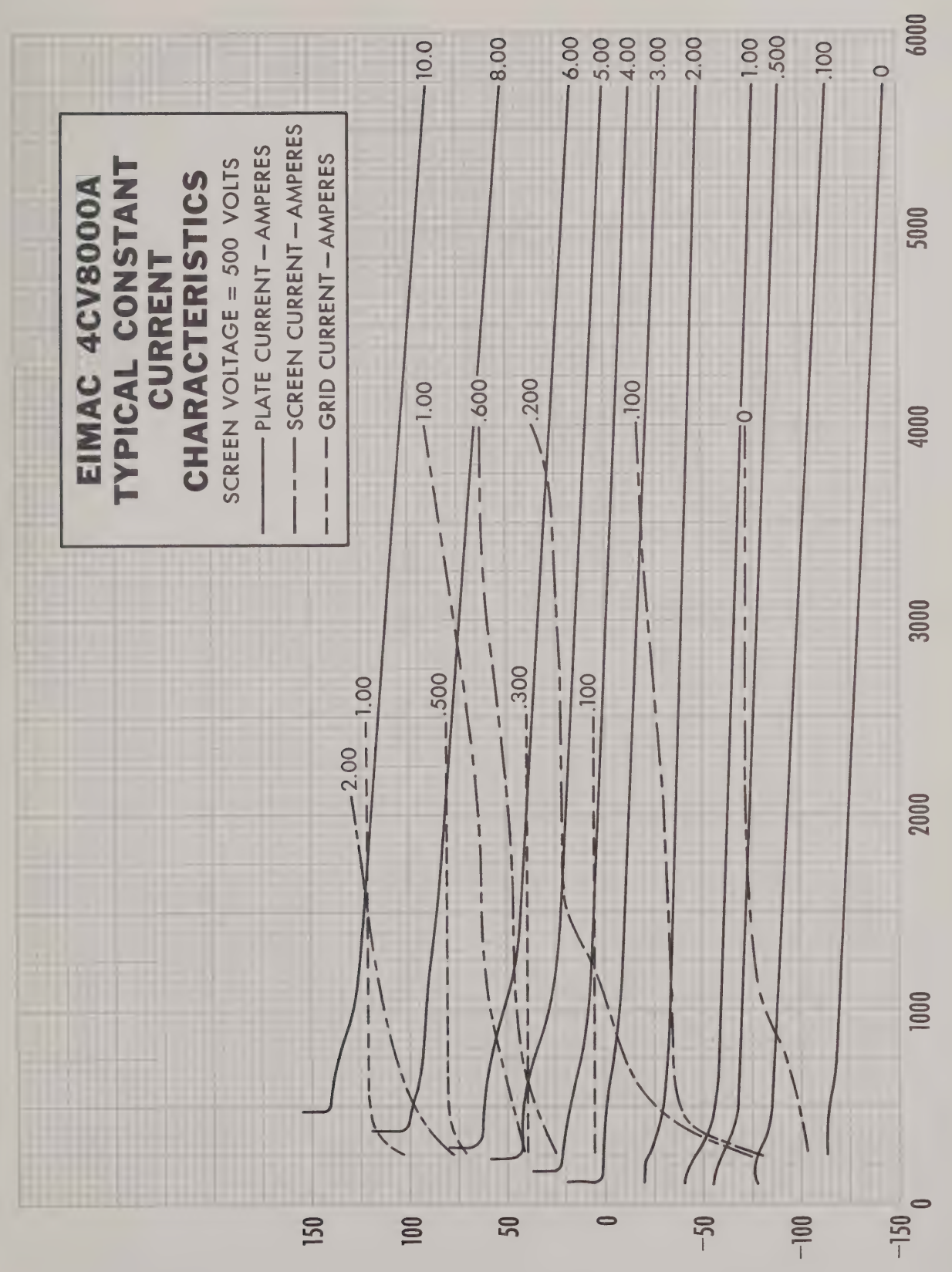
VAPOR COOLING SYSTEM

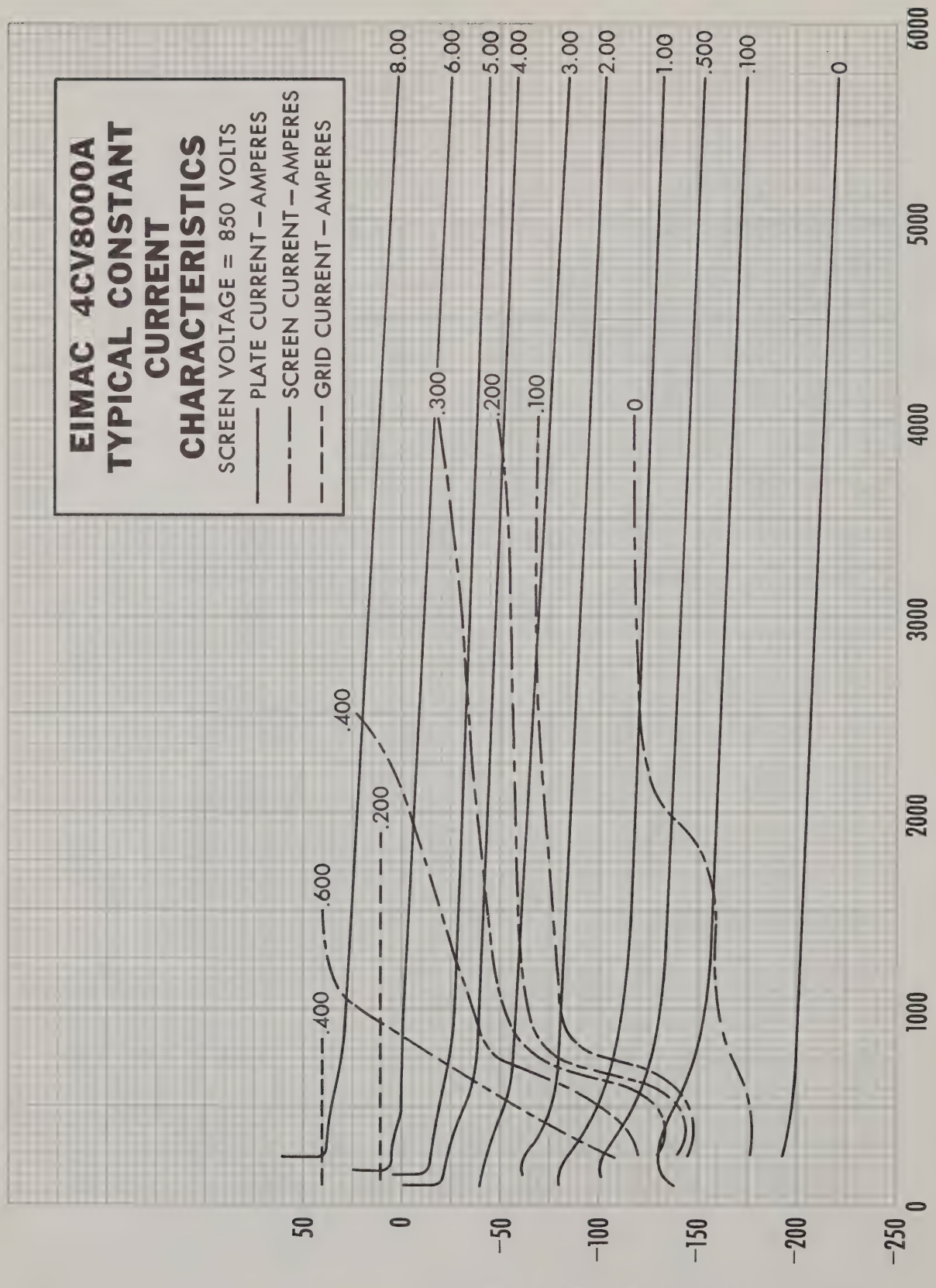


DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.475	3.525		88.27	89.53	--
B	0.860	0.890		21.84	22.61	--
C	2.985	3.025		75.82	76.84	--
D	3.490	3.525		88.65	89.54	--
E	3.472	3.602		88.19	91.49	--
F	6.000	6 200		152.40	157.48	--
G	7.753	7.983		196.93	202.77	--
H	0.965	1.005		24.51	25.53	--
K	0.700	0.730		17.78	18.54	--
L	0.430	0.460		10.92	11.68	--
M	0.160	0.180		4.06	4.57	--
N	0.018	0.025		0.46	0.64	--
P	1.050	1.100		26.67	27.94	--
R	39°	41°		39°	41°	--
S	89°	91°		89°	91°	--
T	0.485	0.515		12.32	13.08	--
U	1.557	1.567		39.55	39.80	--
V	4.000	4.175		101.60	106.05	--
W	--	--	2.968	--	--	75.39
X	--	--	7.875	--	--	200.03
Y	--	--	0.344	--	--	8.74
Z	1.785	1.915	--	45.34	48.64	--



NOTES:
1. AREA FOR MEASURING ANODE FLANGE TEMPERATURE.
2. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.


EIMAC 4CV8000A
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
10.0
8.00
6.00
5.00
4.00
3.00
2.00
1.00
.500
.100
0
2.00
1.00
.500
.300
.100
1.00
.600
.200
.100
0
GRID VOLTAGE – VOLTS
150
100
50
0
–50
–100
–150
0
1000
2000
3000
4000
5000
6000
PLATE VOLTAGE – VOLTS

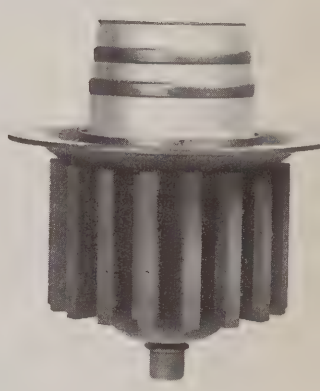

EIMAC 4CV8000A
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 850 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
8.00
6.00
5.00
4.00
3.00
2.00
1.00
.500
.100
0
.300
.200
.100
0
.400
.200
.600
.400
50
0
–50
–100
–150
–200
–250
0
1000
2000
3000
4000
5000
6000
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – VOLTS

EITEL-McCULLOUGH, INC.

TENTATIVE DATA

4CV20,000A

VAPOR-COOLED RADIAL-BEAM POWER-TETRODE



The Eimac 4CV20,000A is a vapor-cooled, ceramic-metal, power tetrode designed for use as an oscillator, modulator, or amplifier in audio and radio-frequency applications. The vapor-cooled anode is conservatively rated at 20 kilowatts of plate dissipation when mounted in an Eimac BR-200 boiler.

A pair of these tubes in class AB_1 audio frequency or radio frequency linear amplifier service will deliver 35 kilowatts output. The frequency for maximum ratings is 30 megacycles; operation to 110 megacycles is possible at reduced input.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amps
Amplification Factor (Grid-Screen)		4.5		
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	108		122	uuf
Output	18		23	uuf
Feedback			1.0	uuf
Direct Interelectrode Capacitances, Grounded Grid:				
Input	48		58	uuf
Output	18		23	uuf
Feedback			1.0	uuf
Frequency for Maximum Ratings			30	Mc

MECHANICAL

Base	Special, Concentric
Recommended Socket	Eimac, SK-300A
Recommended Boiler	Eimac, BR-200
Operating Position	Axis vertical, base up
Cooling	Vapor & Forced air
Maximum Seal Temperature	250° C
Maximum Anode Core Temperature	250° C
Maximum Over-all Dimensions:	
Height	9.13 inches
Diameter	7.75 inches
Net Weight	21 pounds

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS

DC PLATE VOLTAGE (to 30 Mc)	7500 MAX. VOLTS
(30-60 Mc)	7000 MAX. VOLTS
(60-110 Mc)	6500 MAX. VOLTS
DC SCREEN VOLTAGE	1500 MAX. VOLTS
DC PLATE CURRENT (to 30 Mc)	3.0 MAX. AMPS
(30-60 Mc)	2.8 MAX. AMPS
(60-110 Mc)	2.6 MAX. AMPS
PLATE DISSIPATION	20,000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Below 30 Mc)

DC Plate Voltage	6000	7500 volts
DC Screen Voltage	500	500 volts
DC Grid Voltage	-290	-300 volts
DC Plate Current	3.0	3.0 amps
DC Screen Current*	500	500 mA
DC Grid Current	290	290 mA
Peak RF Grid Voltage*	520	530 volts
Driving Power	150	155 watts
Plate Output Power	12,900	17,000 watts

*Approximate Values

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PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 MAX. VOLTS
DC SCREEN VOLTAGE	1000 MAX. VOLTS
DC PLATE CURRENT	2.5 MAX. AMPS
PLATE DISSIPATION*	13,500 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

* Corresponds to 20,000 watts at 100-percent sine-wave modulation.

** Approximate values.

TYPICAL OPERATION
(Frequencies below 30 megacycles)

DC Plate Voltage	4000	5000	volts
DC Screen Voltage	500	500	volts
Peak AF Screen Voltage (For 100%) modulation)	470	490	volts
DC Grid Voltage	-320	-340	volts
DC Plate Current	2.2	2.2	amps
DC Screen Current**	335	330	mA
DC Grid Current**	160	150	mA
Peak RF Grid Voltage**	490	510	volts
Grid Driving Power	78.5	76.5	watts
Plate Dissipation	3050	3250	watts
Plate Output Power	5750	7750	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB_1

MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	7500 MAX. VOLTS
DC SCREEN VOLTAGE	1500 MAX. VOLTS
DC PLATE CURRENT	4.0 MAX. AMPS
PLATE DISSIPATION	20,000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

* Per Tube

**Approximate values.

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	5000	7500	volts
DC Screen Voltage	1500	1500	volts
DC Grid Voltage	-250	-260	volts
Max-Signal Plate Current	8.0	8.0	amps
Zero-Signal Plate Current	4.0	4.0	amps
Max-Signal Screen Current**	330	300	mA
Peak RF Driving Voltage**	240	250	volts
Driving Power	0	0	watts
Load Resistance, Plate-to-Plate	1180	2060	ohms
Max-Signal Plate Dissipation*	9700	12,500	watts
Max-Signal Plate Output Power	20,600	35,000	watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	7500 MAX. VOLTS
DC SCREEN VOLTAGE	1500 MAX. VOLTS
DC PLATE CURRENT	4.0 MAX. AMPS
PLATE DISSIPATION	20,000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

* Approximate values

TYPICAL OPERATION (Peak-Envelope or Modulation-Crest Conditions.

DC Plate Voltage	5000	7500	volts
DC Screen Voltage	1500	1500	volts
DC Grid Voltage	-250	-260	volts
Max-Signal Plate Current	4.0	4.0	amps
Zero-Signal Plate Current	2.0	2.0	amps
Max-Signal Screen Current*	165	150	mA
Peak RF Grid Voltage*	240	250	volts
Driving Power	0	0	watts
Plate Dissipation	9700	12,500	watts
Plate Output Power	10,300	17,500	watts
Resonant Load Impedance	590	1030	ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance is made for circuit losses of any kind. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

MOUNTING — The 4CV20,000A must be operated with its axis vertical, base up in an Eimac BR-200 boiler. Care must be exercised when installing to insure that the boiler is level, the water is at the proper level and that the flange of the tube makes a vapor tight seal against the rubber "O" ring and boiler. A typical vapor cooling system is shown below.

SOCKET — The Eimac SK-300A socket is available for use with the 4CV20,000A. Filament, control grid and screen grid connections are made to this socket.

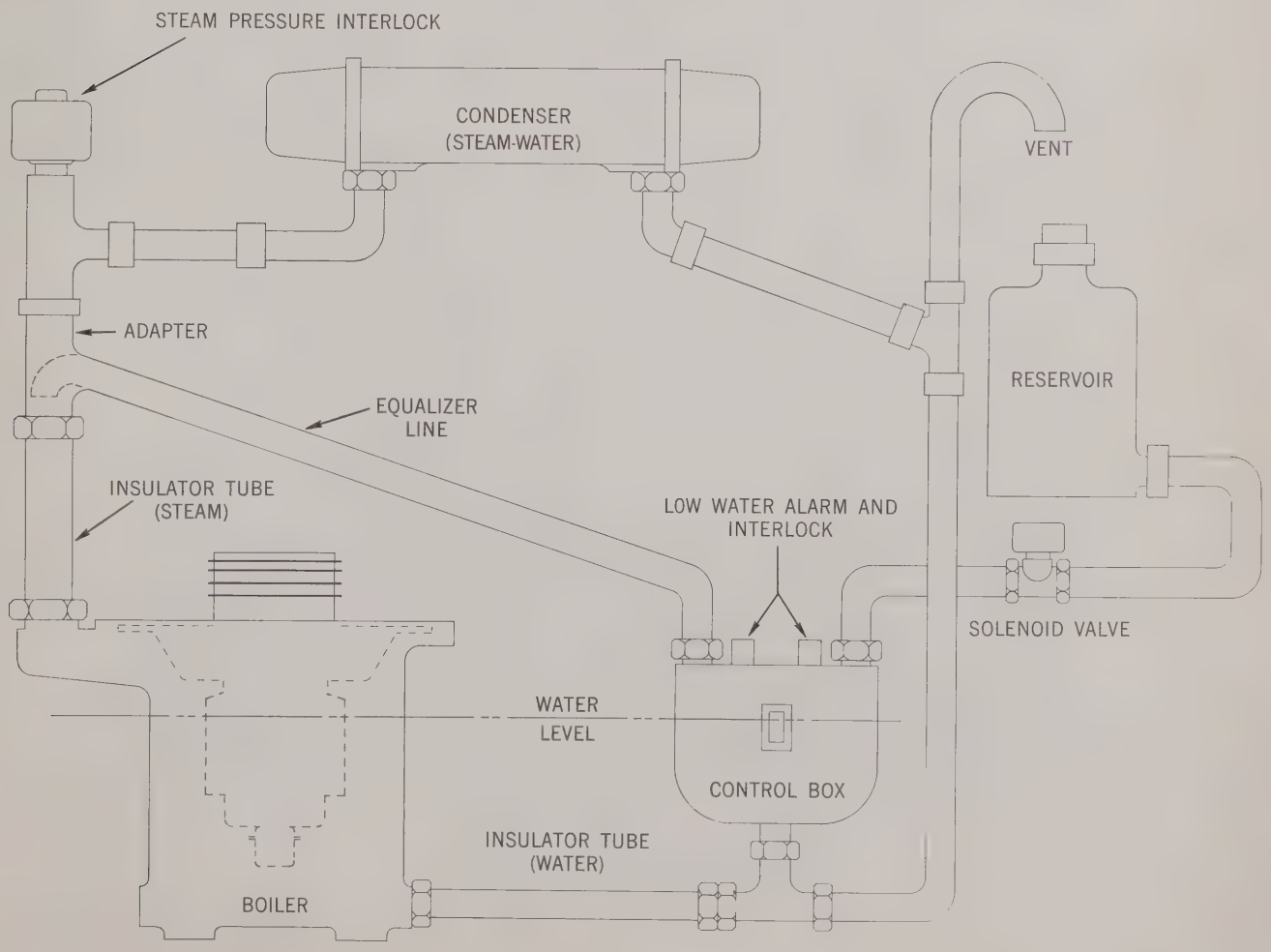
COOLING — Cooling is accomplished by immersing the anode in the distilled water filled BR-200 boiler. The energy dissipated at the anode causes the water to boil at the surfaces of the anode, be converted into steam and be carried away to the condenser. The boiling action keeps the anode surfaces at approximately 100°C. In a properly designed boiler-tube system (such as the 4CV20,000A and BR-200), it is extremely unlikely that the anode surfaces will ever exceed 110°C - well below the 250°C maximum rating - at full dissipation ratings.

The water in the boiler must be maintained at a constant level as indicated by the mark on the boiler, just below the top of the fins on the anode cooler. This is accomplished automatically in the vapor cooling system shown. Condensate from the condenser is returned to the boiler to maintain this constant fluid level. Any losses or drops in liquid level are sensed by the control box, CB-202. A low water level in the control box activates the solenoid water valve, allowing make-up water from the reservoir to enter the boiler. When the proper level is reached, the control box de-energizes the solenoid, stopping the flow from the reservoir. A second switch in the control box is energized if the water level drops to a lower level because of an empty reservoir or a constriction in the line. This switch may be used to shut down the equipment or activate an alarm.

For reliable operation, it is important that the control box and boiler be mounted so that the level sensed by the control box is exactly the same as the level in the boiler.

Cooling of the tube base is accomplished by blowing 25-50 CFM of air into the socket in the area of the filament seals.

VAPOR COOLING SYSTEM



ELECTRICAL

FILAMENT OPERATION — The rated filament voltage for the 4CV20,000A is 7.5 volts. Filament voltage, as measured at the socket, must be maintained at 7.5 volts plus or minus five percent to obtain maximum tube life. The use of a constant voltage filament transformer is recommended.

CONTROL-GRID OPERATION — The 4CV20,000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. Grid dissipation is the product of the dc grid current and the peak positive grid voltage swing.

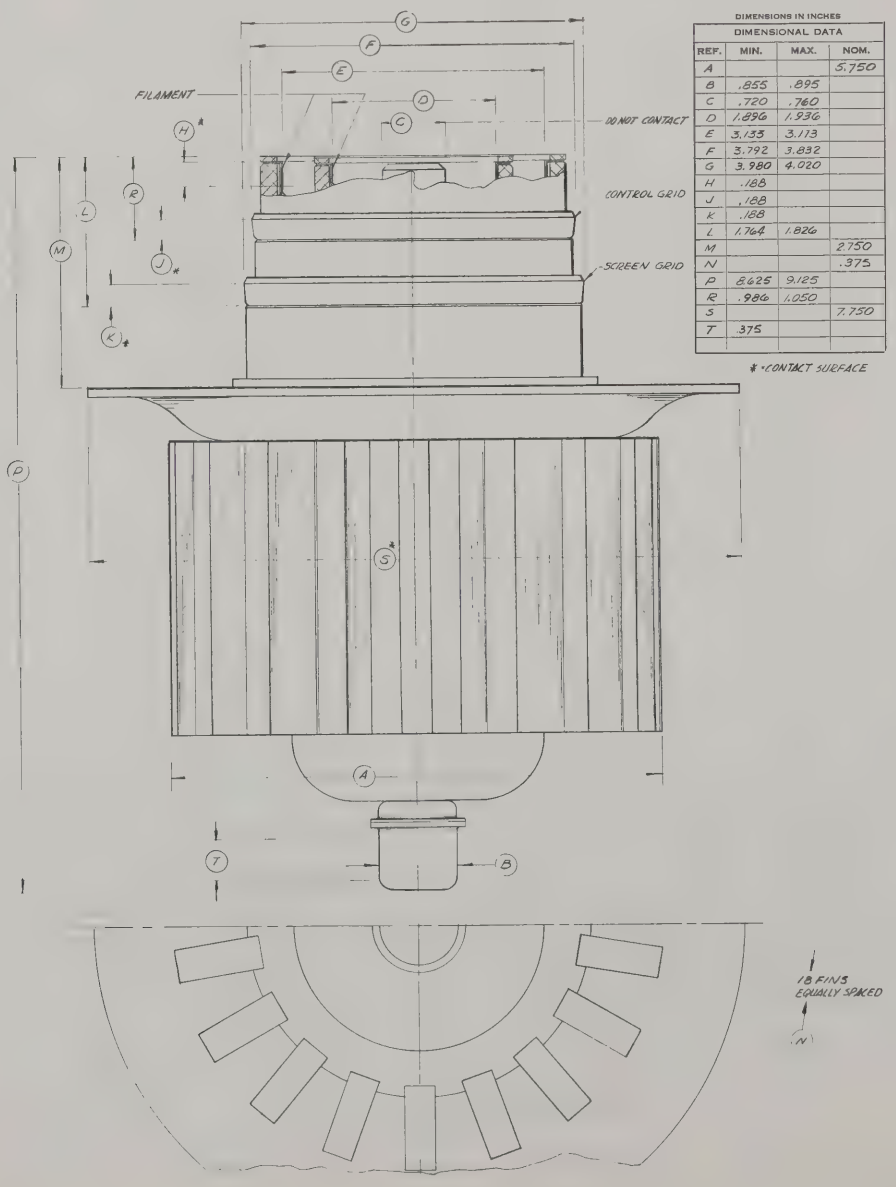
SCREEN-GRID OPERATION — The power dissipated by the screen must not exceed 250 watts. Screen dissipation, in cases where no ac is applied to the screen is the product of screen voltage and screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power and screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation in the event of these failures.

PLATE DISSIPATION — The plate dissipation rating of 20,000 watts attainable through vapor cooling provides a large margin of safety. It is unlikely that this rating will be exceeded, even during tuning periods.

When the 4CV20,000A is used as a plate-modulated rf amplifier, this rating is reduced to 13,500 watts with a reduced plate input rating of 5000 volts and 2.5 amps.

SPECIAL APPLICATIONS — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing Department, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California for information and recommendations.

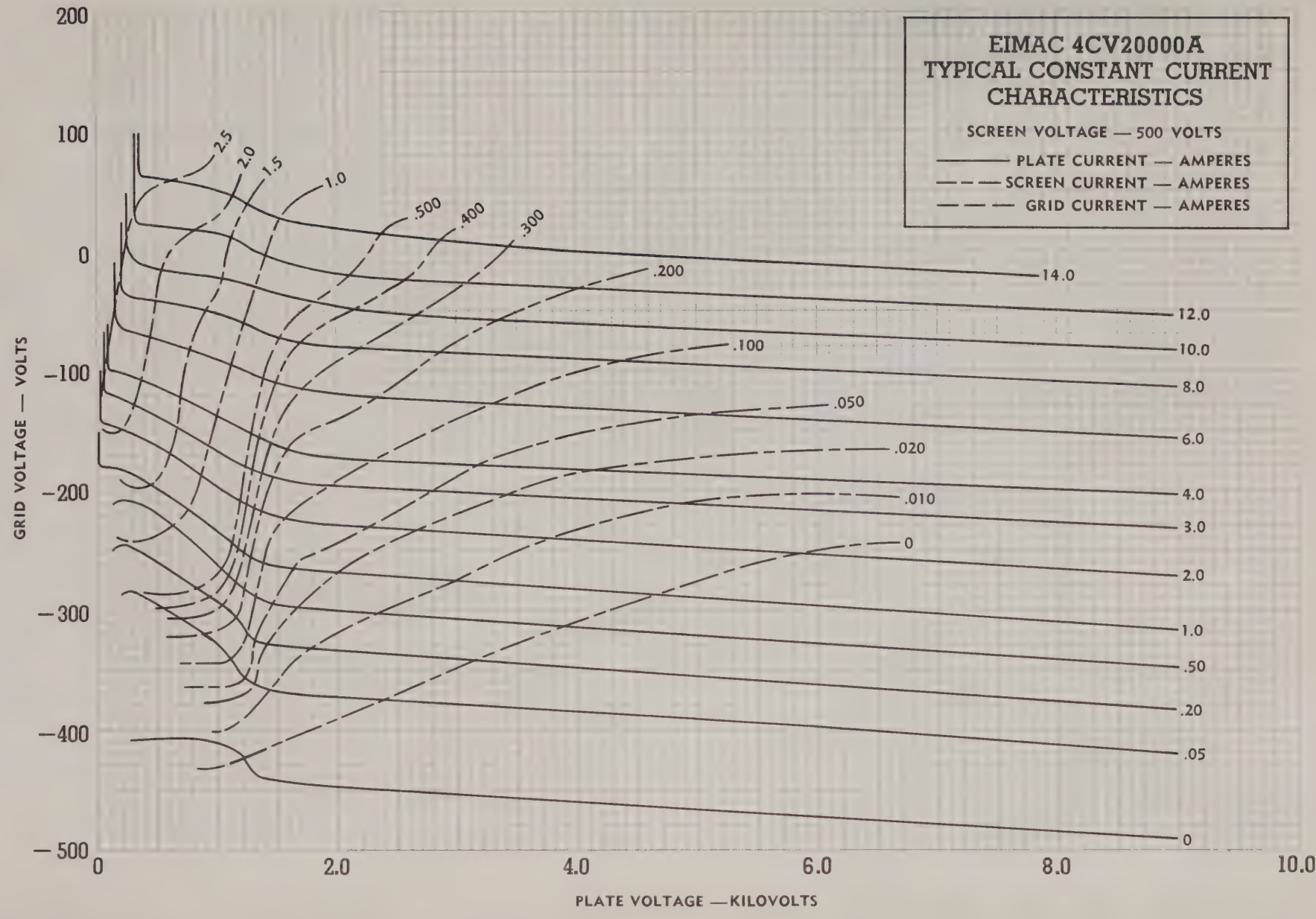


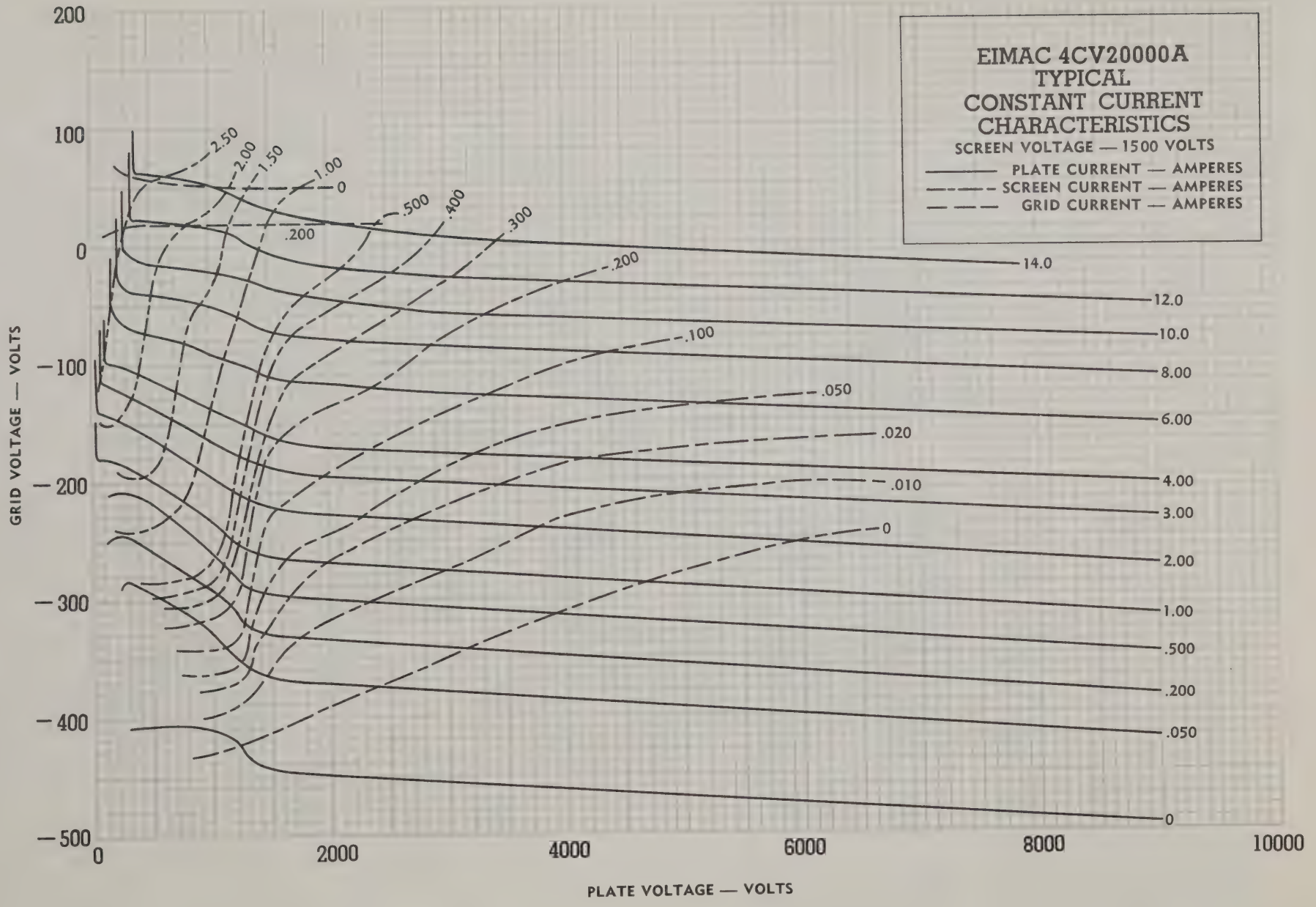
DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A			5.750
B	.855	.895	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.113	
F	3.792	3.832	
G	3.980	4.020	
H	.188		
J	.188		
K	.188		
L	1.764	1.826	
M			2.750
N			.375
P	8.625	9.125	
R	.986	1.050	
S			7.750
T	.375		

* CONTACT SURFACE


EIMAC 4CV20000A
TYPICAL CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
200
100
0
−100
−200
−300
−400
−500
2.5
2.0
1.5
1.0
.500
.400
.300
.200
.100
.050
.020
.010
0
14.0
12.0
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.50
.20
.05
0
0
2.0
4.0
6.0
8.0
10.0
PLATE VOLTAGE —KILOVOLTS

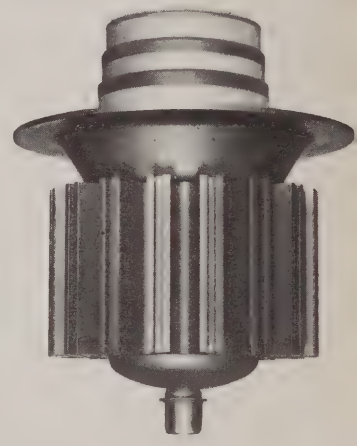

EIMAC 4CV20000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 1500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
200
100
0
−100
−200
−300
−400
−500
0
2000
4000
6000
8000
10000
2.50
2.00
1.50
1.00
0
.500
.400
.300
.200
.200
.100
.050
.020
.010
0
14.0
12.0
10.0
8.00
6.00
4.00
3.00
2.00
1.00
.500
.200
.050
0

EITEL-McCULLOUGH, INC.

TENTATIVE DATA

4CV35,000A

VAPOR-COOLED RADIAL-BEAM POWER-TETRODE



The Eimac 4CV35,000A is a ceramic-metal power tetrode intended for use as a Class-C amplifier in radio-frequency applications. It features a new type of internal mechanical structure which results in higher RF operating efficiency. Low RF losses in this mechanical structure permit operation of the 4CV35,000A at full ratings up to 110 megacycles. The 4CV35,000A is also recommended for Class-AB audio-frequency and radio-frequency linear power amplifier service. The vapor-cooled anode is rated at 35 kilowatts of plate dissipation, making the tube attractive for low efficiency applications.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		6.3		volts
Current	152		168	amps
Amplification Factor (Grid-Screen) (average)		4.5		

	Min.	Max.	
Direct Interelectrode Capacitances, Grounded Cathode:			
Input	158	172	uuf
Output	22.0	27.0	uuf
Feedback		2.0	uuf
Direct Interelectrode Capacitances, Grounded Grid and Screen:			
Input	63.0	78.0	uuf
Output	23.0	28.0	uuf
Feedback		0.3	uuf

MECHANICAL

Base	Special, concentric
Maximum Seal Temperature	250° C
Maximum Anode Core Temperature	250° C
Recommended Socket	Eimac, SK-300A
Recommended Boiler	Eimac, BR-200
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	9.44 inches
Diameter	7.75 inches
Cooling	Forced air
Net Weight	20 pounds
Shipping Weight (Approximate)	35 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 MAX. VOLTS
DC SCREEN VOLTAGE	2,000 MAX. VOLTS
DC PLATE CURRENT	5.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	200 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	7500	10,000	volts
DC Screen Voltage	750	750	volts
DC Grid Voltage	-515	-540	volts
DC Plate Current	4.95	4.8	amps
DC Screen Current	.580	.585	amp
DC Grid Current	.360	.320	amp
Peak RF Grid Voltage	675	700	volts
Driving Power	240	225	watts
Plate Dissipation	9000	10,000	watts
Plate Output Power	27,000	38,000	watts

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PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions unless noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	8000 MAX. VOLTS
DC SCREEN VOLTAGE	1500 MAX. VOLTS
DC PLATE CURRENT	4.0 MAX. AMPS
PLATE DISSIPATION*	23,000 MAX. WATTS
SCREEN DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	200 MAX. WATTS

*Corresponds to 35,000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION

DC Plate Voltage	6000	8000	volts
DC Screen Voltage	750	750	volts
Peak AF Screen Voltage (For 100% modulation)	-740	710	volts
DC Grid Voltage	-600	-640	volts
DC Plate Current	3.75	3.65	amps
DC Screen Current	.450	.430	mA
DC Grid Current	.185	.180	mA
Peak RF Grid Voltage	800	840	volts
Grid Driving Power	150	150	watts
Plate Dissipation	5100	5800	watts
Plate Output Power	17,400	23,500	watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	10,000 MAX. VOLTS
DC SCREEN VOLTAGE	2000 MAX. VOLTS
DC PLATE CURRENT	6.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	200 MAX. WATTS

*Per Tube

**Approximate Values

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	8000	10,000	volts
DC Screen Voltage	1500	1500	volts
DC Grid Voltage	-290	-300	volts
Max-Signal Plate Current	10.7	10.7	amps
Zero-Signal Plate Current*	5.0	5.0	amps
Max-Signal Screen Current**	.390	.340	mA
Zero-Signal Screen Current	0	0	amps
Peak AF Driving Voltage*	280	290	volts
Driving Power	0	0	watts
Load Resistance, Plate-to-Plate	1680	2200	ohms
Max-Signal Plate Dissipation*	16,800	20,500	watts
Max-Signal Plate Output Power	50,000	66,000	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 MAX. VOLTS
DC SCREEN VOLTAGE	2000 MAX. VOLTS
DC PLATE CURRENT	6.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	450 MAX. WATTS
GRID DISSIPATION	200 MAX. WATTS

*Approximate Values

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions.

DC Plate Voltage	8000	10,000	volts
DC Screen Voltage	1500	1500	volts
DC Grid Voltage	-290	-300	volts
Max-Signal Plate Current	5.35	5.35	amps
Zero-Signal Plate Current	2.5	2.5	amps
Max-Signal Screen Current*	.195	.170	mA
Peak RF Grid Voltage	280	290	volts
Driving Power	0	0	watts
Plate Dissipation	16,800	20,500	watts
Plate Output Power	25,000	33,000	watts
Resonant Load Impedance	840	1100	ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance is made for circuit losses of any kind. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

MOUNTING — The 4CV35,000A must be operated with its axis vertical, base up in an Eimac BR-200 boiler. Care must be exercised when installing to insure that the boiler is level, the water is at the proper level and that the flange of the tube makes a vapor tight seal against the rubber O-ring and boiler. A typical vapor cooling system is shown on the opposite page.

SOCKET — The Eimac SK-310 socket is available for use with the 4CV35,000A. Filament, control grid and screen grid connections are made to this socket.

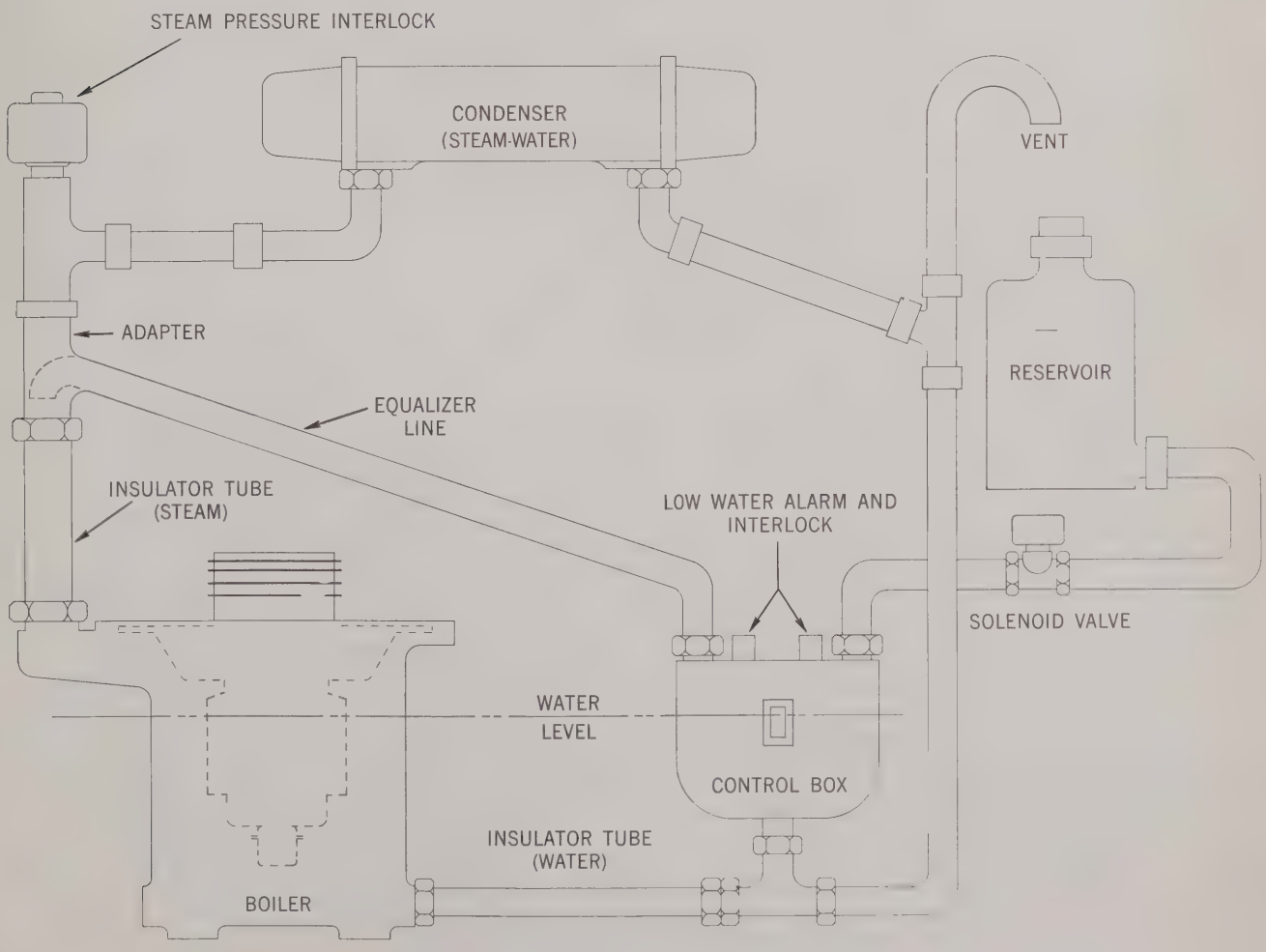
COOLING — Cooling is accomplished by immersing the anode in the distilled water filled BR-200 boiler. The energy dissipated at the anode causes the water to boil at the surfaces of the anode, be converted into steam and be carried away to the condenser. The boiling action keeps the anode surfaces at approximately 100° C. In a properly designed boiler-tube system (such as the 4CV35,000A and BR-200), it is extremely unlikely that the anode surfaces will ever exceed 110° C - well below the 250° C maximum rating - at full dissipation ratings.

The water in the boiler must be maintained at a constant level. Just below the top of the fins on the anode cooler. This is accomplished automatically in the vapor cooling system shown. Condensate from the condenser is returned to the boiler to maintain this constant fluid level. Any losses or drops in liquid level are sensed by the control box. CB-202. A low water level in the control box activates the solenoid water valve, allowing make-up water from the reservoir to enter the boiler. When the proper level is reached, the control box de-engergizes the solenoid, stopping the flow from the reservoir. A second switch in the control box is energized if the water level drops to a lower level because of an empty reservoir or a constriction in the line. This switch may be used to shut down the equipment or activate an alarm.

For reliable operation, it is important that the control box and boiler be mounted so that the level sensed by the control box is exactly the same as the level in the boiler.

Cooling of the tube base is accomplished by blowing 25 - 50 CFM of air through the socket from the sides.

VAPOR COOLING SYSTEM



ELECTRICAL

FILAMENT OPERATION — The rated filament voltage for the 4CV35,000A is 6.3 volts. Filament voltage, as measured at the socket, must be maintained at 6.3 volts plus or minus five percent to obtain maximum tube life. The use of a constant voltage filament transformer is recommended.

CONTROL-GRID OPERATION — The 4CV35,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. Grid dissipation is the product of the dc grid current and the peak positive grid voltage swing.

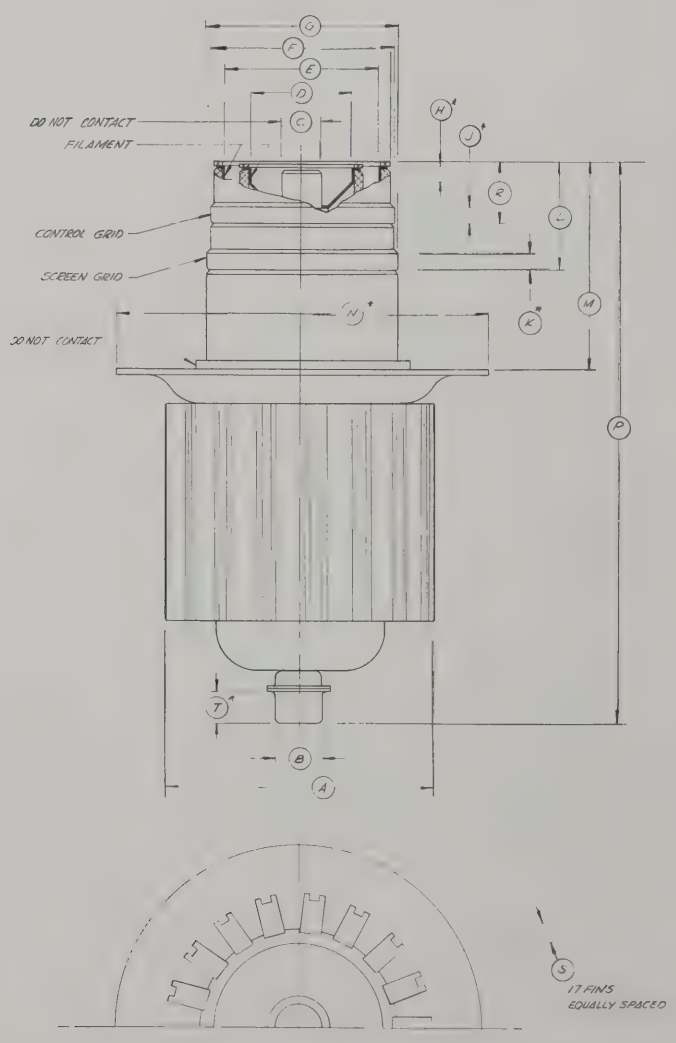
SCREEN-GRID OPERATION — The power dissipated by the screen must not exceed 450 watts. Screen dissipation, in cases where no ac is applied to the screen is the product of screen voltage and screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power and screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation in the event of these failures.

PLATE DISSIPATION — The plate dissipation rating of 35,000 watts attainable through vapor cooling provides a large margin of safety. It is unlikely that this rating will be exceeded, even during tuning periods.

When the 4CV35,000A is used as a plate-modulated rf amplifier, this rating is reduced to 23,000 watts with a reduced plate input rating of 8000 volts and 4.0 amps.

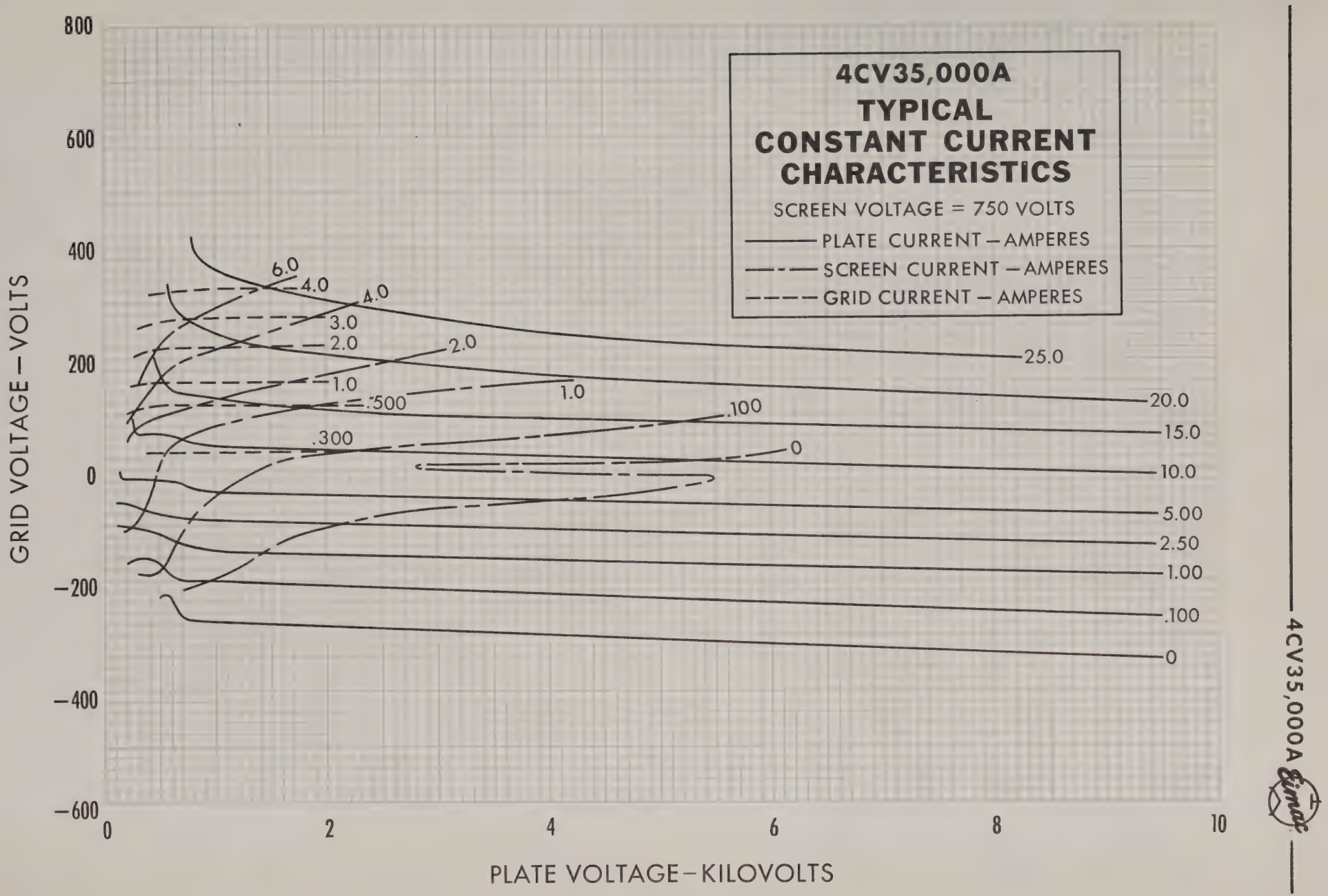
SPECIAL APPLICATIONS — If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing Department, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California for information and recommendations.

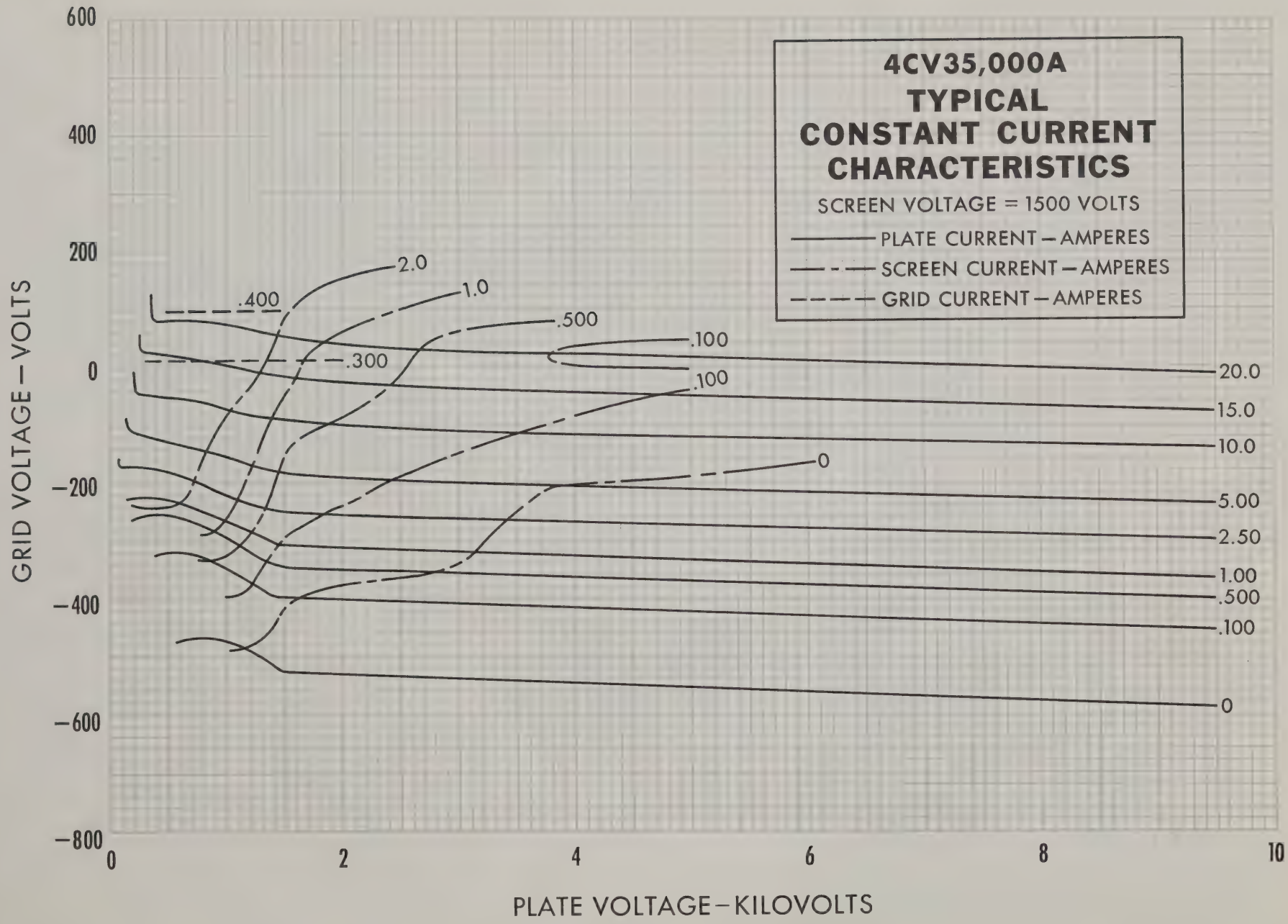


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	6.125	6.375	
B	.855	.895	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
G	3.980	4.020	
H	.168		
J	.188		
K	.188		
L	1.764	.826	
M			3.250
N			1.750
P	3.250	3.150	
R	.986	1.050	
S			.500
T	.375		

* CONTACT SURFACE


4CV35,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
800
600
400
200
0
–200
–400
–600
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
6.0
4.0
4.0
3.0
2.0
2.0
1.0
1.0
.500
.100
.300
0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0


4CV35,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
600
400
200
0
–200
–400
–600
–800
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
2.0
1.0
.500
.100
.400
.300
.100
0
20.0
15.0
10.0
5.00
2.50
1.00
.500
.100
0

EIMAC
Division of Varian

4CV50,000E

VAPOR COOLED POWER TETRODE

The EIMAC 4CV50,000E is a ceramic/metal, vapor-cooled power tetrode intended for use at the 50 to 100 kilowatt output power level. This tube is characterized by low input and feedback capacitances and low internal lead inductances. A rugged mesh thoriated tungsten filament provides adequate emission over the long operating life. It is recommended for use as a class C rf amplifier or oscillator, a class AB rf linear amplifier or a class AB push-pull af amplifier or modulator. The 4CV50,000E is also useful as a plate and screen modulated class C rf amplifier. The vapor cooled anode is rated at 50 kilowatts dissipation.



Shown with boiler removed.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Mesh Thoriated Tungsten		
Voltage	12 ± 0.6	V
Current, at 12.0 volts	220	A
Amplification Factor (Average)		
Grid to Screen	4.5	
Direct Interelectrode Capacitances (grounded cathode)		
Input	310	pF
Output	53	pF
Feedback	0.7	pF
Frequency of Maximum Rating:		
CW	110	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

MECHANICAL

Maximum Overall Dimensions:	
Length (less boiler)	11.500 in; (292.1 mm)
Diameter	9.531 in; (241.0 mm)
Net Weight (less boiler)	31.5 lb; (14.3 kg)
Operating Position	Vertical, base down
Maximum Operating Temperature:	
Ceramic/Metal Seals and terminals	250°C
Cooling	Vapor and Forced Air
Base	Special
Recommended Air System Socket	EIMAC SK-2000 Series
Recommended Boiler	EIMAC BR-700 Series

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RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION	50,000	WATTS
SCREEN DISSIPATION	1,500	WATTS
GRID DISSIPATION	400	WATTS

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions.

Plate Voltage	10.0	kVdc
Screen Voltage	1.8	kVdc
Grid Voltage [1]	-260	Vdc
Zero-Signal Plate Current	3.4	Adc
Single Tone Plate Current	9.14	Adc
Peak rf Grid Voltage 2	230	v
Resonant Load Impedance	600	Ω
Plate Dissipation	35	kW
Plate Output Power	57	kW

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION	50,000	WATTS
SCREEN DISSIPATION	1,500	WATTS
GRID DISSIPATION	400	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	15.0	15.0	kVdc
Screen Voltage	1.5	1.5	kVdc
Grid Voltage	-800	-800	Vdc
Plate Current	9.0	11.5	Adc
Screen Current [1]	0.9	0.83	Adc
Grid Current [1]	125	160	mAdc
Peak rf Grid Voltage [1]	880	925	v
Calculated Driving Power [1]	110	150	W
Plate Dissipation	25	36	kW
Plate Output Power	110	137	kW
Resonant Load Impedance	820	615	Ω

1. Approximate value

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	15,000	VOLTS
DC SCREEN VOLTAGE	2,000	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION [1]	33,000	WATTS
SCREEN DISSIPATION [2]	1,500	WATTS
GRID DISSIPATION [2]	400	WATTS

1. Corresponds to 50,000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	9.0	14.0	kVdc
Screen Voltage	750	750	Vdc
Grid Voltage	-600	-600	Vdc
Plate Current	7.41	9.25	Adc
Screen Current [3]	0.69	1.15	Adc
Grid Current	0.333	0.833	Adc
Peak af Screen Voltage [3] (100% modulation)	750	750	v
Peak rf Grid Voltage [3]	750	820	v
Calculated Driving Power	250	685	W
Plate Dissipation	12.5	21.5	kW
Plate Output Power	54.2	110	kW

3. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_1, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION	50,000	WATTS
SCREEN DISSIPATION	1,500	WATTS
GRID DISSIPATION	400	WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	15.0	kVdc
Screen Voltage	1.25	kVdc
Grid Voltage [1/3]	-280	Vdc
Zero-Signal Plate Current	5.0	Adc
Max. Signal Plate Current	18.6	Adc
Max. Signal Screen Current [1]	0.6	Adc
Peak af Grid Voltage [2]	275	v
Peak Driving Power	0	w
Max. Signal Plate Dissipation [2]	41.7	kW
Plate Output Power	195	kW
Load Resistance (plate to plate)	1870	Ω

1. Approximate value.
2. Per tube.
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater: Current at 12.0 volts	200	230	A
Interelectrode Capacitances (grounded cathode connection)			
Input	290	330	pF
Output	47.0	57.0	pF
Feedback	---	1.0	pF
Interelectrode Capacitances (grounded grid connection)			
Input	130	150	pF
Output	47.0	57.0	pF
Feedback	---	0.5	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CV50,000E must be operated with its axis vertical. The base of the tube must be down.

SOCKET - The EIMAC sockets type SK-2000 series are recommended for use with the 4CV-50,000E.

COOLING - Cooling is accomplished by immersing the anode in the distilled water filled EIMAC boiler. The energy dissipated at the anode causes the water to boil at the surfaces of the anode, to be converted into steam and be carried away to the condenser. The boiling action keeps the anode surfaces at approximately 100°C. In a properly designed boiler-tube system, it is extremely unlikely that the anode surfaces will ever exceed 110°C at full dissipation ratings.

The water in the boiler must be maintained at a constant level which may be accomplished automatically in an EIMAC vapor cooling system. Condensate from the condenser is returned to the boiler to maintain a constant coolant level. Any losses or drops in coolant level are sensed and makeup water enters the boiler from the reservoir. When the proper level is reached the flow from the reservoir is stopped automatically. A switch is energized when the reservoir water level drops to a low level. This switch may be used to shut down the equipment or activate an alarm.

Air cooling of the tube base is required whenever filament voltage is applied. A minimum air flow of 100 cfm should be ducted toward the center of the EIMAC SK-2000 socket from a blower or fan. Pressure drop through the SK-2000 socket is approximately 0.5 inches of water. The air system must be capable of supplying 100 cfm into this head.

The water used as a coolant in the vapor phase cooling system is continuously distilled. It is imperative that the resistivity of the water be maintained above 200,000 ohms/cm^3. The entry of any contaminator to the system must be prevented. The use of any lead bearing alloys such as brass or soft/solder in fabrication of the cooling system must be avoided since steam leaches out the lead, contaminating the coolant.

Suitable materials for a cooling system are copper, hard solder, and polypropylene. Any contamination of the water causes leakage current to flow through the water supply lines to ground. When the resistivity is low this leakage current power will cause boiling in the lines, interfering with the proper operation of the system.

The user must be prepared to flush the system on initial startup to purge any contamination which may have entered the components during shipment or assembly.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the socket with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 4CV-50,000E is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CV50,000E by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CV50,000E. At some point in filament voltage there will be noticeable reduction in plate current, or power output, or an increase in age slightly higher than the point at which performance appears to deteriorate. This point should be periodically checked to maintain proper operation.

GRID OPERATION - The 4CV50,000E control grid is rated at 400 watts of dissipation. Grid dissipation is the approximate product of grid current and peak positive grid voltage.

SCREEN OPERATION - The power dissipated by the screen grid must not exceed 1500 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is dependent on rms screen voltage and rms screen current. Plate voltage, plate load or bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

The 4CV50,000E may exhibit reversed screen current to a greater or lesser degree depending on operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished with a bleeder resistor connected from screen to cathode, or an electron-tube regulator circuit may be employed in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed.

PLATE DISSIPATION - The plate dissipation of 50 kilowatts attainable through vapor cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CV50,000E is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 33,300 watts.

HIGH VOLTAGE - Normal operating voltages used with the 4CV50,000E are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CV50,000E, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

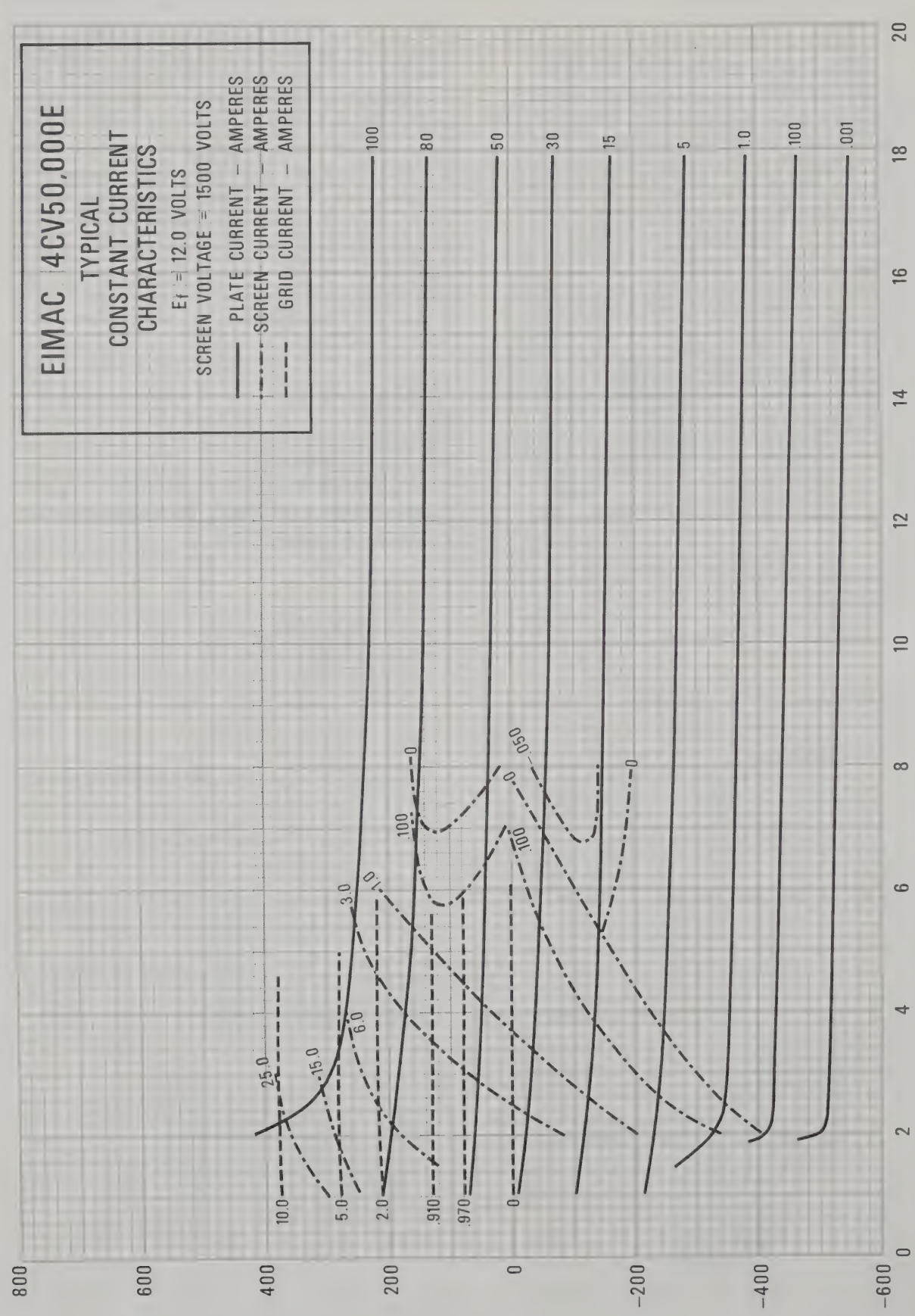
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 4CV-50,000E, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

FAULT PROTECTION - In addition to normal plate overcurrent interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltages.

In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc is recommended.

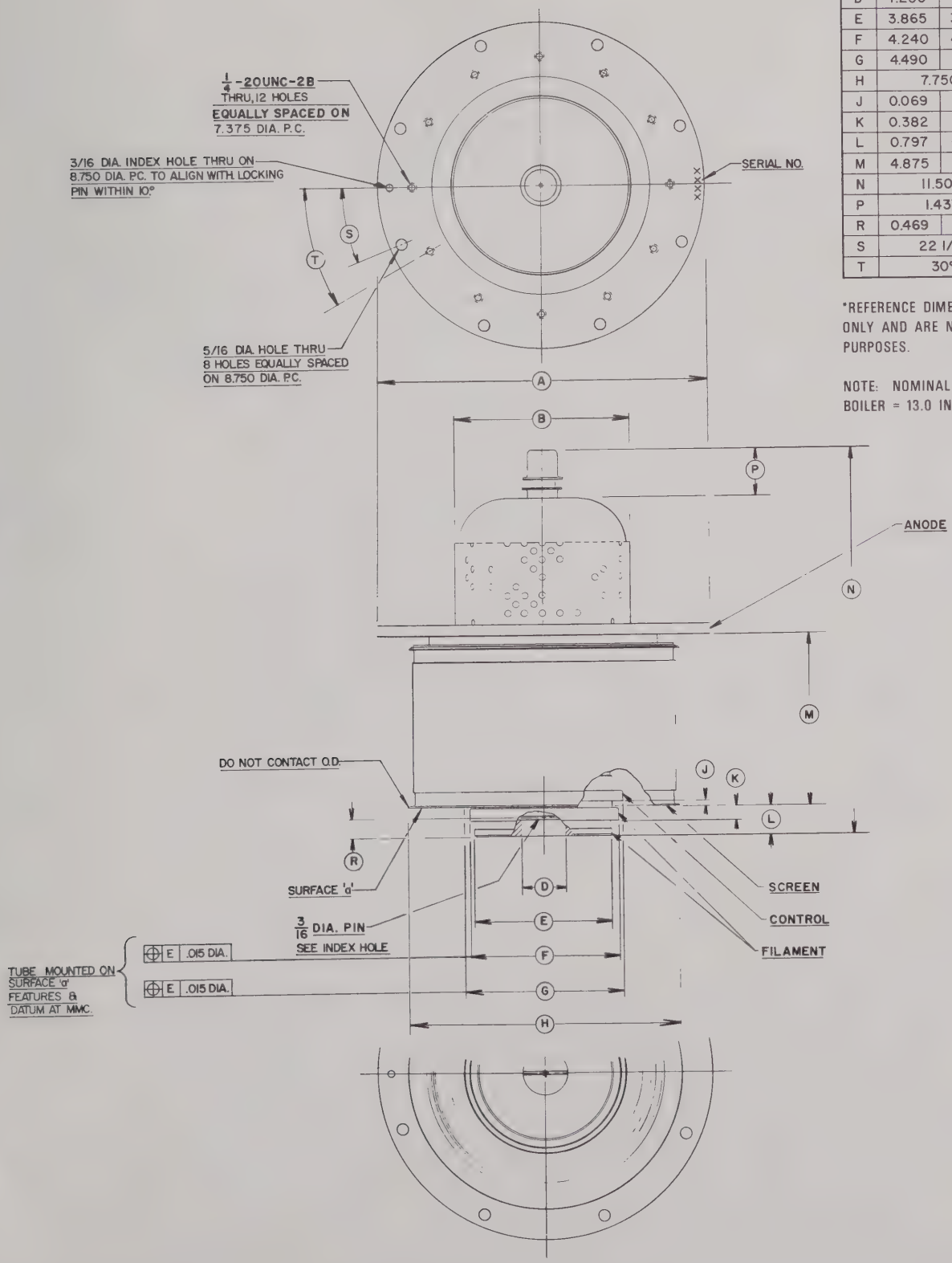
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Application Engineering, Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


EIMAC 4CV50,000E
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
Ef = 12.0 VOLTS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
CURVE #3993

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	9.468	9.531	240.49	242.09
B	5.000	5.250	127.00	133.35
C	--	--	--	--
D	1.230	1.270	31.24	32.26
E	3.865	3.885	98.17	98.68
F	4.240	4.260	107.70	108.20
G	4.490	4.510	114.05	114.55
H	7.750*		196.85*	
J	0.069	0.149	1.75	3.78
K	0.382	0.462	9.70	11.73
L	0.797	0.922	20.24	23.42
M	4.875	5.000	123.83	127.00
N	11.500*		292.10*	
P	1.437*		36.50*	
R	0.469	0.531	11.91	13.49
S	22 1/2°*		22 1/2°*	
T	30°*		30°*	

*REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.

NOTE: NOMINAL OVERALL HEIGHT WITH BOILER = 13.0 INCHES (330.2 mm).



4CV50,000J

TECHNICAL DATA

VAPOR COOLED
POWER TETRODE

The EIMAC 4CV50,000J is a ceramic/metal, vapor-cooled power tetrode intended for use at the 50 to 100 kilowatt output power level. This tube is characterized by low input and feedback capacitances and low internal lead inductances. A rugged mesh thoriated tungsten filament provides adequate emission over the long operating life. It is recommended for use as a class AB_1 rf linear amplifier. The vapor cooled anode is rated at 50 kilowatts dissipation.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Mesh Thoriated Tungsten	
Voltage	12 ± 0.6 V
Current, at 12.0 volts	220 A
Amplification Factor (Average)	
Grid to Screen	4.5
Direct Interelectrode Capacitances (grounded cathode)	
Cin	310 pF
Cout	48 pF
Cgp	1.0 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

MECHANICAL

Overall Dimensions:	
Length (less boiler)	11.500 in; 292.1 mm
Diameter	9.531 in; 241.0 mm
Net Weight (less boiler)	31.5 lb; 14.3 kg
Operating Position	Vertical, base down
Maximum Operating Temperature:	
Ceramic/Metal Seals and terminals	250°C
Cooling	Vapor and Forced Air
Base	Special
Recommended Air System Socket	EIMAC SK-2000 Series
Recommended Boiler	EIMAC BR-710, 720

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RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION	50,000	WATTS
SCREEN DISSIPATION	1,500	WATTS
GRID DISSIPATION	400	WATTS

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.
3. The IMD products are referenced against one tone of a two-equal tone signal.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven Peak Envelope or Modulation Crest Conditions

Plate Voltage	8.3	kVdc
Screen Voltage	1.5	kVdc
Grid Voltage 1	-250	Vdc
Zero-Signal Plate Current	3.6	Adc
Single-Tone Plate Current	9.8	Adc
Peak rf Grid Voltage 2	250	v
Resonant Load Impedance	413	Ω
Plate Dissipation	35	kW
Plate Output Power	45	kW
Intermod. Distortion Products 3		
3rd Order	-46	dB
5th Order	-60	dB

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater: Current at 12.0 volts	200	230	A
Interelectrode Capacitances (grounded cathode connection)			
Cin	290	330	pF
Cout	42.0	53.0	pF
Cgp	---	1.5	pF
Interelectrode Capacitances (grounded grid connection)			
Cin	113	137	pF
Cout	45.0	55.0	pF
Cgk	---	0.5	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CV50,000J must be operated with its axis vertical. The base of the tube must be down.

SOCKET - The EIMAC sockets type SK-2000 series are recommended for use with the 4CV-50,000J.

COOLING - Cooling is accomplished by immersing the anode in the distilled water filled EIMAC boiler. The energy dissipated at the anode causes the water to boil at the surfaces of the anode, to be converted into steam and be carried away to the condenser. The boiling action keeps the anode surfaces at approximately 100°C. In a properly designed boiler-tube system, it is extremely unlikely that the anode surfaces will ever exceed 110°C at full dissipation ratings.

The water in the boiler must be maintained at a constant level which may be accomplished automatically in an EIMAC vapor cooling system. Condensate from the condenser is returned to the boiler to maintain a constant coolant level. Any losses or drops in coolant level are sensed and makeup water enters the boiler from the reservoir. When the proper level is reached the flow from the reservoir is stopped automatically. A switch is energized when the reservoir water level drops to a low level. This switch may be used to shut down the equipment or activate an alarm.

Air cooling of the tube base is required whenever filament voltage is applied. A minimum air

flow of 100 cfm should be ducted toward the center of the EIMAC SK-2000 socket from a blower or fan. Pressure drop through the SK-2000 socket is approximately 0.5 inches of water. The air system must be capable of supplying 100 cfm into this head.

The water used as a coolant in the vapor phase cooling system is continuously distilled. It is imperative that the resistivity of the water be maintained above 200,000 ohms/cm . The entry of any contaminator to the system must be prevented. The use of any lead bearing alloys such as brass or soft/solder in fabrication of the cooling system must be avoided since steam leaches out the lead, contaminating the coolant.

Suitable materials for a cooling system are copper, hard solder, and polypropylene. Any contamination of the water causes leakage current to flow through the water supply lines to ground. When the resistivity is low this leakage current power will cause boiling in the lines, interfering with the proper operation of the system.

The user must be prepared to flush the system on initial startup to purge any contamination which may have entered the components during shipment or assembly.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the socket with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 4CV-50,000J is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CV50,000J by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CV50,000J. At some point in filament voltage there will be noticeable reduction in plate current, or power output, or an increase in distortion. Operation must be at a filament voltage slightly higher than the point at which performance appears to deteriorate. This point should be periodically checked to maintain proper operation.

GRID OPERATION - The 4CV50,000J control grid is rated at 400 watts of dissipation. Grid dissipation is the approximate product of grid current and peak positive grid voltage.

SCREEN OPERATION - The power dissipated by the screen grid must not exceed 1500 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is dependent on rms screen voltage and rms screen current. Plate voltage, plate load or bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

The 4CV50,000J may exhibit reversed screen current to a greater or lesser degree depending on operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished with a bleeder resistor connected from screen to cathode, or an electron-tube regulator circuit may be employed in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed.

PLATE DISSIPATION - The plate dissipation of 50 kilowatts attainable through vapor cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CV50,000J is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 33,300 watts.

HIGH VOLTAGE - Normal operating voltages used with the 4CV50,000J are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CV50,000J, operating at its rated voltages and currents, is a potential

X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

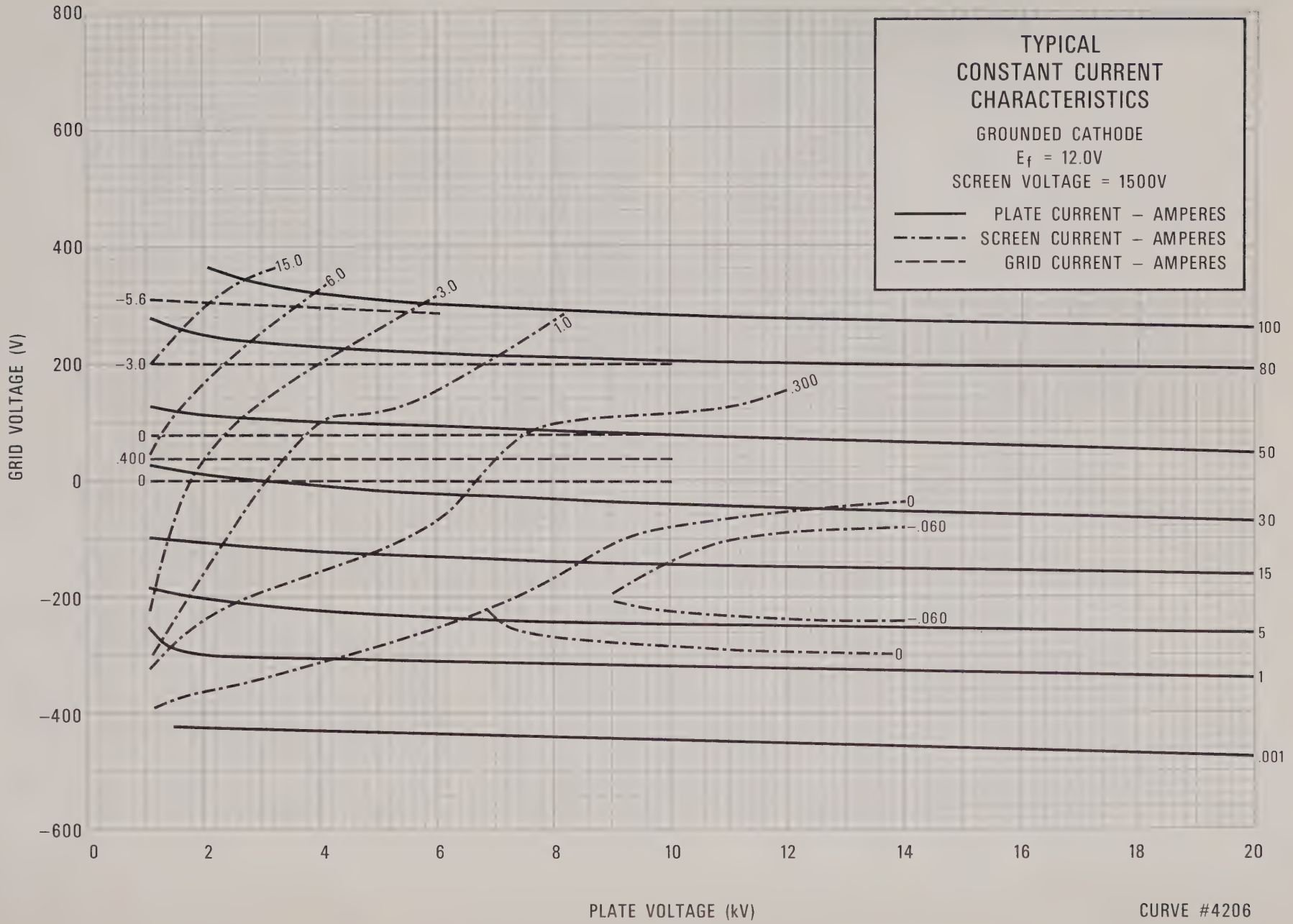
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 4CV-50,000J, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

FAULT PROTECTION - In addition to normal plate overcurrent interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltages.

In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with the tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc is recommended.

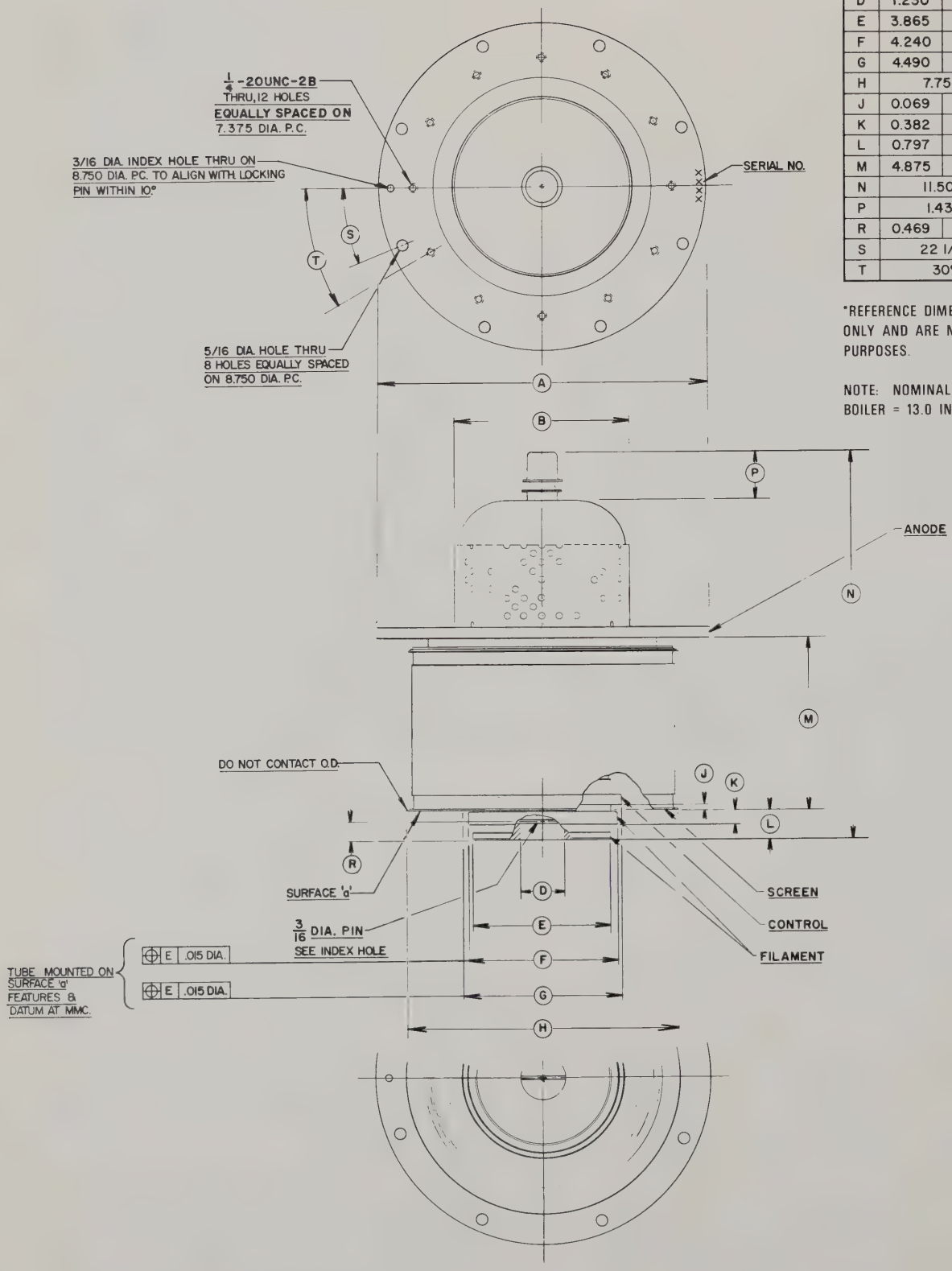
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Application Engineering, Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 12.0V
SCREEN VOLTAGE = 1500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
800
600
400
200
0
–200
–400
–600
0
2
4
6
8
10
12
14
16
18
20
PLATE VOLTAGE (kV)
15.0
6.0
3.0
1.0
–5.6
–3.0
0
.400
0
.300
0
–.060
–.060
0
100
80
50
30
15
5
1
.001
CURVE #4206

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	9.468	9.531	240.49	242.09
B	5.000	5.250	127.00	133.35
C	--	--	--	--
D	1.230	1.270	31.24	32.26
E	3.865	3.885	98.17	98.68
F	4.240	4.260	107.70	108.20
G	4.490	4.510	114.05	114.55
H	7.750*		196.85*	
J	0.069	0.149	1.75	3.78
K	0.382	0.462	9.70	11.73
L	0.797	0.922	20.24	23.42
M	4.875	5.000	123.83	127.00
N	11.500*		292.10*	
P	1.437*		36.50*	
R	0.469	0.531	11.91	13.49
S	22 1/2°*		22 1/2°*	
T	30°*		30°*	

*REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.

NOTE: NOMINAL OVERALL HEIGHT WITH BOILER = 13.0 INCHES (330.2 mm).



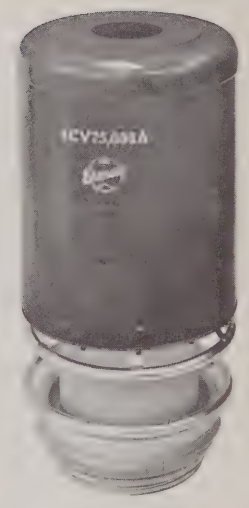
4CV75,000A

TECHNICAL DATA

VAPOR COOLED
POWER TETRODE

The EIMAC 4CV75,000A is a ceramic/metal, vapor-cooled power tetrode intended for use at the 50 to 80 kilowatt output power level. It is recommended for use as a Class C rf amplifier or oscillator, a Class AB rf linear amplifier, or a Class AB push-pull af amplifier or modulator. The 4CV-75,000A is also useful as a plate and screen modulated Class C rf amplifier.

The vapor-cooled anode is rated at 75 kilowatts of dissipation when mounted in the EIMAC BR-320 boiler assembly.



BR-320 Boiler installed

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	10 ± 0.5	V
Current, at 10.0 volts	300	A
Amplification Factor (Grid-Screen, average)	4.5	
Direct Interelectrode Capacitances (grounded filament)		
Cin	440	pF
Cout	55	pF
Cgp	2.3	pF
Direct Interelectrode Capacitances (grounded grid)		
Cin	175	pF
Cout	57	pF
Cpk	0.4	pF
Frequency for Maximum Ratings:		
CW	30	MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as a result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

MECHANICAL

Maximum Overall Dimensions: (without boiler)	
Length	17.450 in; 443.2 mm
Diameter	9.300 in; 236.2 mm
Net Weight	60 lb; 27.3 kg
Operating Position	Vertical, base down
Maximum Operating Temperature:	
Base and Anode Seals	250°C
Recommended Socket	EIMAC SK-1500 Series
Recommended Boiler	EIMAC BR-320
Cooling	Vapor and Forced Air

(Effective 6-15-71) © by Varian Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	15,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15	AMPERES
PLATE DISSIPATION	75,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	10.0	15.0	kVdc
Screen Voltage	1.5	1.5	kVdc
Grid Voltage [1]	-290	-340	Vdc
Zero-Signal Plate Current	2.0	1.0	Adc
Single Tone Plate Current	8.7	7.55	Adc
Single-Tone Screen Current [2]	0.385	0.310	Adc
Peak rf Grid Voltage [2]	270	310	v
Plate Dissipation	32	30.5	W
Plate Output Power	55	82.5	kW

1. Adjust to specified zero-signal dc plate current.
2. Approximate value .

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM Telephony (Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	15,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC GRID VOLTAGE	-2000	VOLTS
DC PLATE CURRENT	15	AMPERES
PLATE DISSIPATION	75	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	10.0	15.0	15.0	kVdc
Screen Voltage	750	750	1500	Vdc
Grid Voltage	-425	-480	-1020	Vdc
Plate Current	6.7	6.45	11.8	Adc
Screen Current [1]	0.925	0.810	1.0	Adc
Grid Current [1]	0.320	0.355	0.100	Adc
Peak rf Grid Voltage [1]	575	640	1220	v
Calculated Driving Power	185	225	120	W
Plate Input Power	67	96.5	177	kW
Plate Dissipation	12	14	38	kW
Plate Output Power	55	82.5	139	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	12,500	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC GRID VOLTAGE	-2000	VOLTS
DC PLATE CURRENT	15	AMPERES
PLATE DISSIPATION [1]	50,000	WATTS
SCREEN DISSIPATION [2]	1750	WATTS
GRID DISSIPATION [2]	500	WATTS

1. Corresponds to 75,000 watts at 10% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	7.5	10.0	kVdc
Screen Voltage	750	750	Vdc
Grid Voltage	-460	-520	Vdc
Plate Current	7.0	6.6	Adc
Screen Current [1]	1.2	0.985	Adc
Grid Current [1]	0.375	0.370	mAdc
Peak af Screen Voltage [1] (100% modulation)	640	675	v
Peak rf Grid Voltage [1]	630	680	v
Calculated Driving Power	235	250	W
Plate Input Power	52.5	66	kW
Plate Dissipation	10.5	11	kW
Plate Output Power	42	55	kW

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB_1, Grid Driven

(Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	15,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15	AMPERES
PLATE DISSIPATION	75,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.
2. Per Tube.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	10.0	15.0	kVdc
Screen Voltage	1.5	1.5	Vdc
Grid Voltage [1/3]	-290	-340	Vdc
Zero-Signal Plate Current	4.0	2.0	Adc
Max. Signal Plate Current	17.4	15.1	Adc
Zero-Signal Screen Current [1]	0	0	Adc
Max. Signal Screen Current [1]	0.77	0.62	Adc
Max. Signal Grid Current [1]	0	0	Adc
Peak af Grid Voltage [2]	270	310	v
Peak Driving Power	0	0	w
Plate Input Power	143	195.0	kW
Max. Signal Plate Dissipation	33	30.5	kW
Plate Output Power	110	165	kW
Load Resistance(plate to plate)	1150	2560	Ω

3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 10.0 volts	280	310	A
Cathode Warmup Time	10	---	sec.
Interelectrode Capacitances (grounded filament connection)			
Cin	410	470	pF
Cout	50	60	pF
Cgp	1.5	3.2	pF
Interelectrode Capacitances (grounded grid connection)			
Cin	155	195	pF
Cout	52	62	pF
Cpk	---	0.6	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CV75,000A must be mounted vertically, anode up, in an EIMAC BR-320 boiler. Care must be exercised to insure that the axis of the tube/boiler combination is vertical and that the water in the boiler is at the level indicated on the outline drawing of the tube and boiler The anode flange on the tube must seat securely against the rubber "O" ring, forming a liquid-tight seal between the tube and boiler.

SOCKETING - The EIMAC SK-1500 series is available for use with the 4CV75,000A. Filament, control grid, and screen grid connections are made to this socket. Springfinger contacts on the socket are used to make connections to the concentric rings on the tube base.

COOLING - Anode cooling is accomplished by immersion in a "boiler" filled with distilled water. Energy dissipated by the anode causes the water to boil at the anode surface, be converted into steam, and carried away to an external condenser. The condensate is then returned to the boiler, completing the cycle.

This boiling action maintains the anode surface at a fairly constant temperature near 100°C. The vapor-cooled tube has good overload capabilities; excess dissipation for moderate periods only causes more water to boil.

A control box (EIMAC CB-202) is used to sense water level in the boiler and signal for make-up water from a reservoir, and also to shut down the system in case of low water level. In order to perform its function, the control box must be mounted so that its water level mark is at the same elevation as the water level mark on the boiler.

Since the tube anode and boiler are usually at high potential to ground, water and steam connections to the boiler are made through insulated tubing.

A pressure equalizing line is required between the steam side of the system and the top of the control box. Its function is to provide the same pressure in the control box as in the boiler.

Separate cooling of the tube base is required and is accomplished by directing a minimum of 60 cfm of air at 25°C maximum at sea level (rising to 100 cfm of air at 50°C maximum at sea level) into

the socket from the side, in the area of the filament seals. In addition, a minimum of 2 cfm of air should be directed into the base well of the tube, to maintain a safe temperature in this area. Base air cooling should be applied before or simultaneously with the application of electrode voltages, including the filament, and should be maintained for a short period after all voltages are removed to allow for tube cool-down.

ELECTRICAL

FILAMENT - The rated filament voltage for the 4CV75,000A is 10.0 volts and, as measured at the socket or the base of the tube, should be maintained within plus or minus five percent to obtain maximum tube life and consistent performance.

Filament starting (inrush) current should be limited to a maximum of 900 amperes.

Voltage between filament and the base plates of either tube or the SK-1500 socket should not exceed 100 volts.

CONTROL GRID OPERATION - The 4CV75,000A control grid is rated at 500 watts of dissipation. Grid dissipation is the approximate product of a grid current and peak positive grid voltage.

SCREEN DISSIPATION - The power dissipated by the screen grid must not exceed 1750 watts. Where no ac voltage is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the the dissipation is dependent on rms screen voltage and rms screen current. Plate voltage, plate load, or bias voltage must never be removed while filament and screen voltages are present on the tube since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

The 4CV75,000A may exhibit reverse screen current, depending on operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished with a bleeder resistor connected from screen to cathode, or an electron-tube regulator circuit may be used in the screen supply. A bleeder resistor must be used if a series regulator is employed.

PLATE DISSIPATION - The plate dissipation of 75 kilowatts attainable with vapor cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CV75,000A is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 50 kilowatts.

FAULT PROTECTION - In addition to the normal plate-overcurrent interlock, screen-current interlock, and vapor-cooling control box interlock, it is good practice to protect the tube from internal damage caused by an internal plate arc which may occur at high plate voltages.

A protective resistance of 5 to 25 ohms should always be connected in series with the tube anode, to absorb power-supply stored energy if a plate arc should occur. An electronic crowbar, which will discharge power-supply capacitors in a few microseconds after the start of a plate arc, is recommended.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CV75,000A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

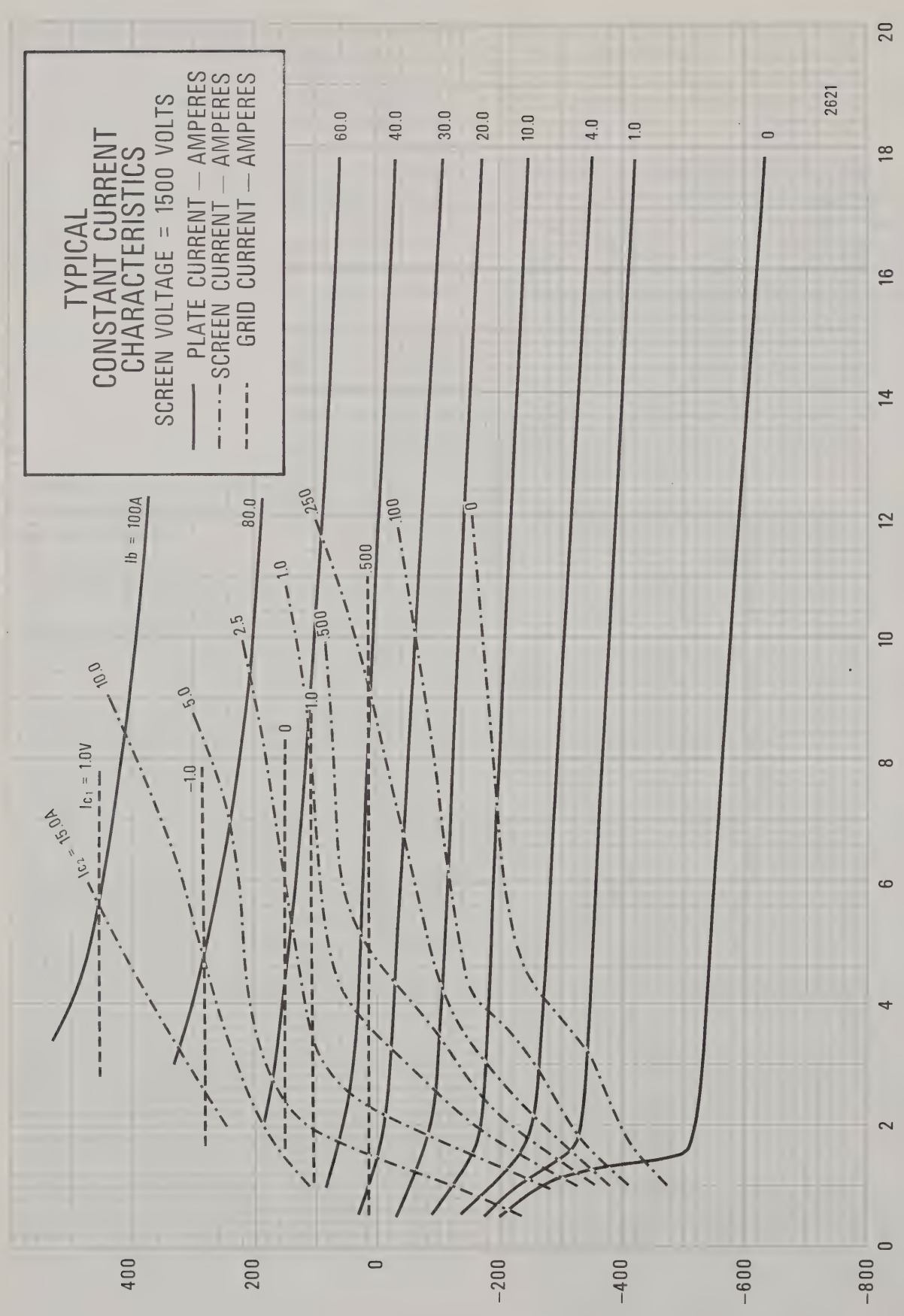
Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

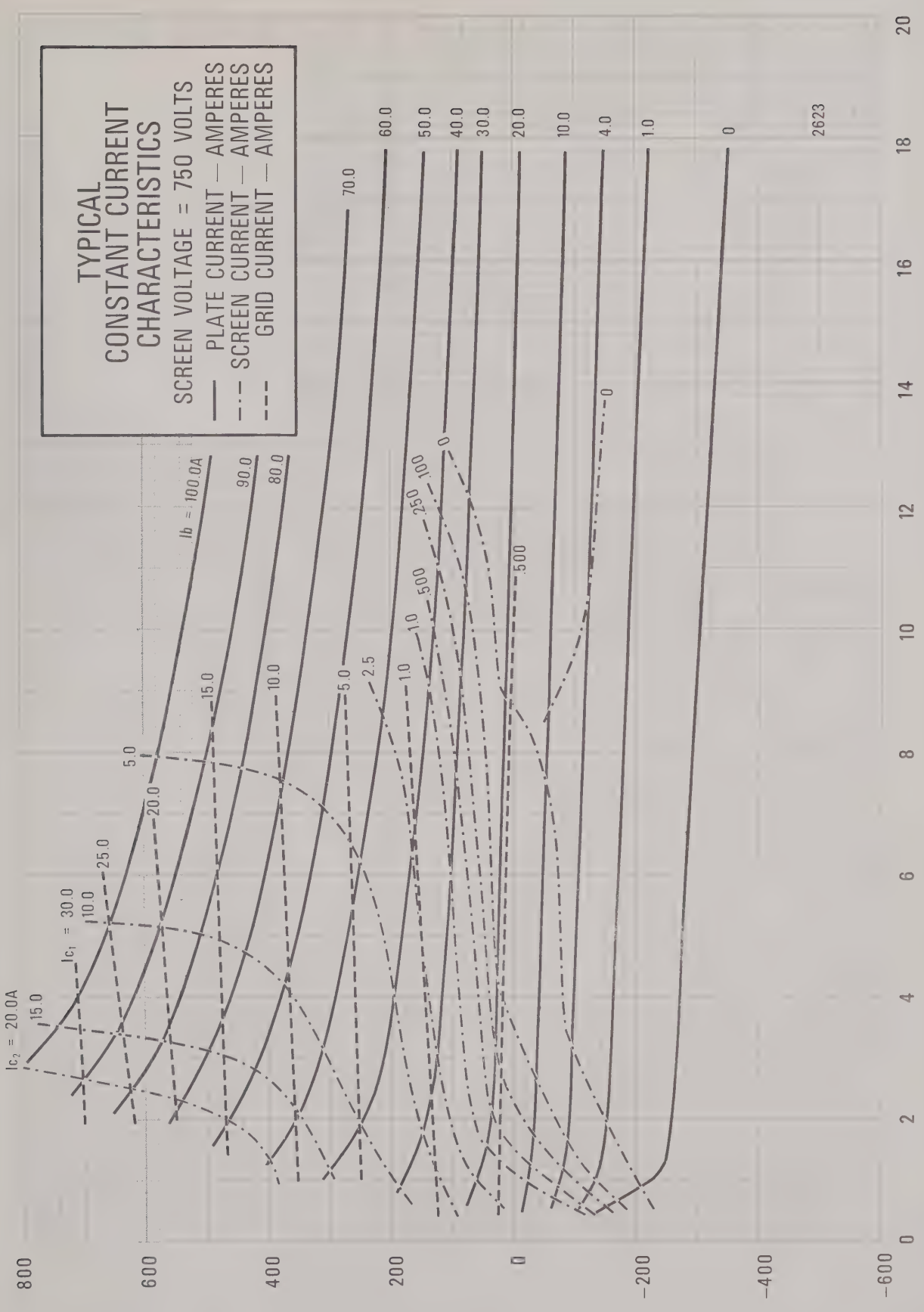
HIGH VOLTAGE - Normal operating voltages used with the 4CV75,000A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to dis-

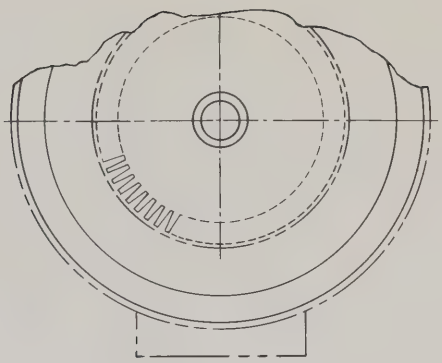
charge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL

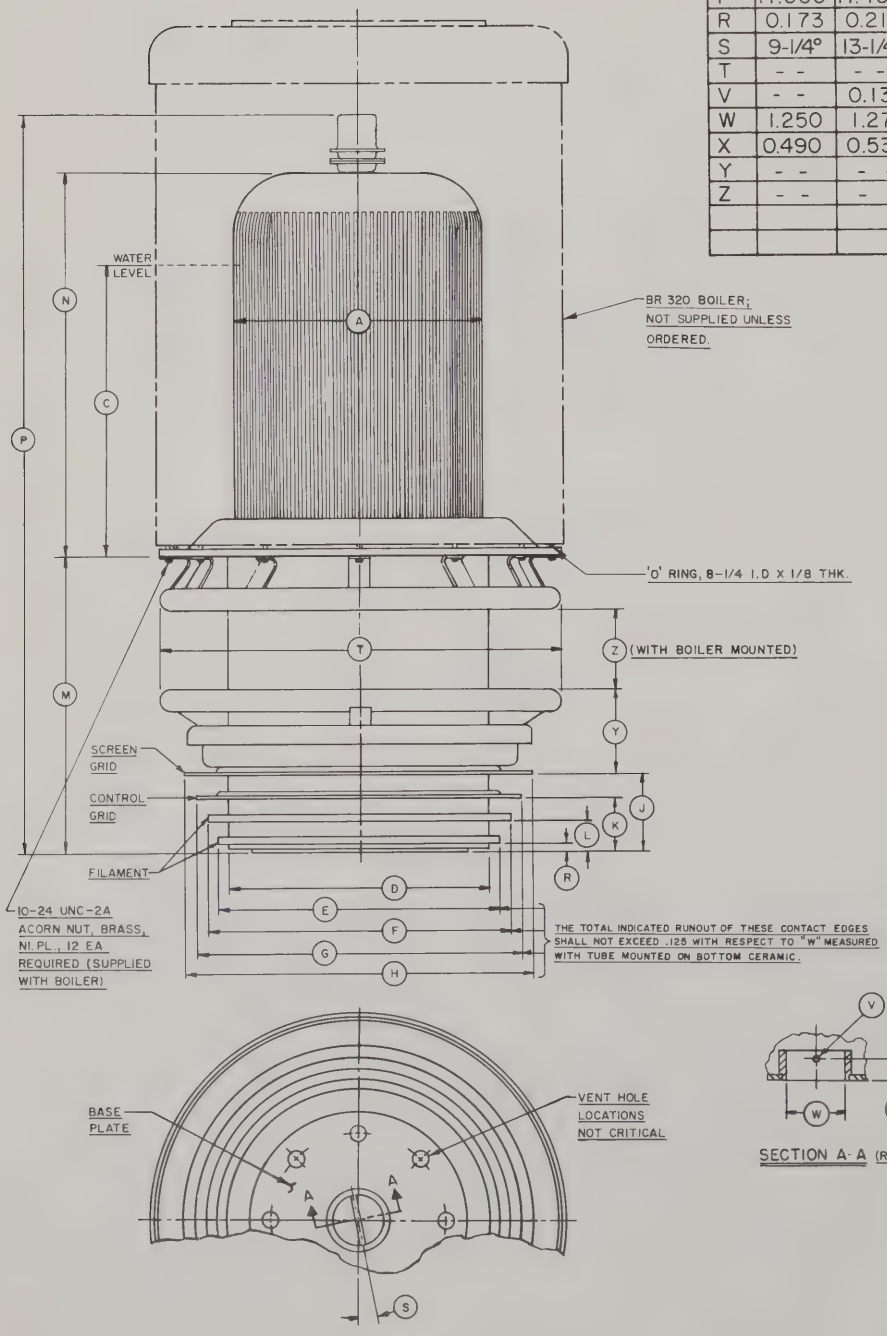
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation of heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
Ib = 100A
Ic1 = 15.0A
Ic2 = 1.0V
10.0
5.0
2.5
1.0
0
80.0
1.0
500
250
60.0
500
100
40.0
0
30.0
20.0
10.0
4.0
1.0
0
2621
400
200
0
-200
-400
-600
-800
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—KILOVOLTS


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
I_{c_2} = 20.0A
15.0
I_{c_1} = 30.0
10.0
25.0
20.0
5.0
15.0
10.0
5.0
2.5
1.0
1.0
500
250
100
0
500
0
I_b = 100.0A
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
4.0
1.0
0
2623
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—KILOVOLTS





SECTION A-A (ROTATED 11 1/4°)

DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	5.562	5.812	- -	141.28	147.63	- -
C	4.500	7.000	- -	114.30	177.80	- -
D	5.980	6.020	- -	151.89	152.91	- -
E	6.510	6.560	- -	165.35	166.62	- -
F	6.980	7.020	- -	177.29	178.30	- -
G	7.480	7.520	- -	189.99	191.00	- -
H	7.975	8.015	- -	202.56	203.58	- -
J	1.750	1.800	- -	44.45	45.72	- -
K	1.220	1.270	- -	30.99	32.26	- -
L	0.690	0.740	- -	17.53	18.80	- -
M	6.942	7.192	- -	176.33	182.68	- -
N	8.725	8.950	- -	221.62	227.33	- -
P	17.000	17.450	- -	431.80	443.23	- -
R	0.173	0.213	- -	4.39	5.41	- -
S	9-1/4°	13-1/4°	- -	- -	- -	- -
T	- -	- -	9.250	- -	- -	234.95
V	- -	0.135	- -	- -	3.43	- -
W	1.250	1.270	- -	31.75	32.26	- -
X	0.490	0.530	- -	12.45	13.46	- -
Y	- -	- -	2.000	- -	- -	50.80
Z	- -	- -	2.000	- -	- -	50.80

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

4CV100,000C

RADIAL-BEAM
POWER TETRODE
VAPOR COOLED

The Eimac 4CV100,000C is a ceramic-metal power tetrode intended for use in the 100 to 200-kilowatt output-power range. It is recommended for use as a Class-C rf amplifier or oscillator, Class-AB_1 rf amplifier, or Class-AB_1 af amplifier or modulator. The vapor-cooled anode is rated at 100 kilowatts maximum dissipation.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	10.0	volts
Current	300	amperes
Amplification Factor (Grid-Screen) (Average)	5.5	
Direct Interelectrode Capacitances, Grounded Cathode (Average):		
Input	430	μμf
Output	45	μμf
Feedback	2.3	μμf
Frequency for Maximum Ratings	30	Mc

MECHANICAL

Base	Special, graduated rings	
Recommended Socket	Eimac, SK-1500	
Operating Position	Axis vertical, base up	
Cooling	Vapor-phase and forced air	
Maximum Seal Temperature	250° C	
Maximum Overall Dimensions:		
Height	17.0	inches
Diameter	10.0	inches
Net Weight	95	pounds

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RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX	VOLTS
DC SCREEN VOLTAGE	2,500 MAX	VOLTS
DC PLATE CURRENT	15 MAX	AMPS
PLATE DISSIPATION	100,000 MAX	WATTS
SCREEN DISSIPATION	1,750 MAX	WATTS
GRID DISSIPATION	500 MAX	WATTS

TYPICAL OPERATION (per tube)

DC Plate Voltage	20,000	volts
DC Screen Voltage	1,500	volts
DC Grid Voltage	-800	volts
DC Plate Current	13.7	amps
DC Screen Current	1.0	amps
DC Grid Current	125	ma
Peak RF Grid Voltage	1,000	volts
Driving Power	125	watts
Plate Dissipation	54,000	watts
Plate Output Power	220,000	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	15,000 MAX	VOLTS
DC SCREEN VOLTAGE	2,000 MAX	VOLTS
DC PLATE CURRENT	15 MAX	AMPS
PLATE DISSIPATION	66,500 MAX	WATTS
SCREEN DISSIPATION	1,750 MAX	WATTS
GRID DISSIPATION	500 MAX	WATTS

TYPICAL OPERATION

DC Plate Voltage	15,000	volts
DC Screen Voltage	750	volts
Peak AF Screen Voltage (for 100% modulation)*	750	volts
DC Grid Voltage	500	volts
DC Plate Current	13.0	amps
DC Screen Current	2.15	amps
DC Grid Current	1.4	amps
Peak RF Grid Voltage	800	volts
Driving Power	1125	watts
Plate Dissipation*	60,000	watts
Plate Output Power	135,000	watts

*Approximate Value

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1, Grid Driven

ABSOLUTE MAXIMUM RATINGS (SINGLE-TONE CONDITIONS) (per tube)

DC PLATE VOLTAGE	20,000 MAX	VOLTS
DC SCREEN VOLTAGE	2,500 MAX	VOLTS
DC PLATE CURRENT	15 MAX	AMPS
PLATE DISSIPATION	100,000 MAX	WATTS
SCREEN DISSIPATION	1,750 MAX	WATTS
GRID DISSIPATION	500 MAX	WATTS

TYPICAL OPERATION (per tube)

DC Plate Voltage	20,000	volts
DC Screen Voltage	1,500	volts
DC Grid Voltage*	-340	volts
Zero-Signal DC Plate Current	3.0	amps
Maximum-Signal DC Plate Current	9.4	amps
Maximum-Signal DC Screen Current	310	ma
Peak RF Grid Voltage	330	volts
Driving Power	0	watts
Plate Dissipation	58,000	watts
Maximum-Signal Plate Output Power	130,000	watts
Resonant Load Impedance	1,250	ohms

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

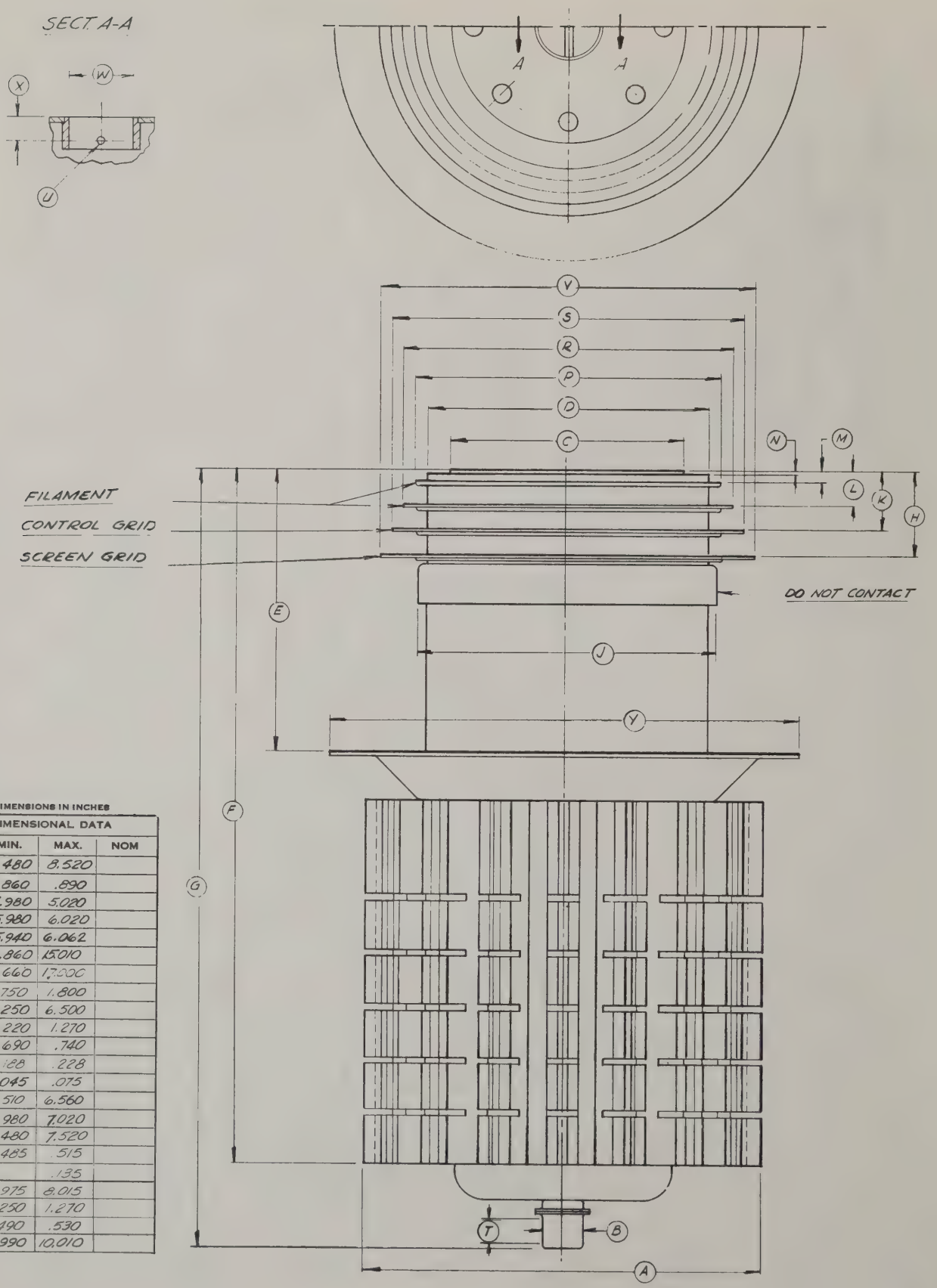
ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	20,000 MAX	VOLTS
DC SCREEN VOLTAGE	2,500 MAX	VOLTS
DC PLATE CURRENT	15 MAX	AMPS
PLATE DISSIPATION	100,000 MAX	WATTS
SCREEN DISSIPATION	1,750 MAX	WATTS
GRID DISSIPATION	500 MAX	WATTS

TYPICAL OPERATION (two tubes, sinusoidal wave)

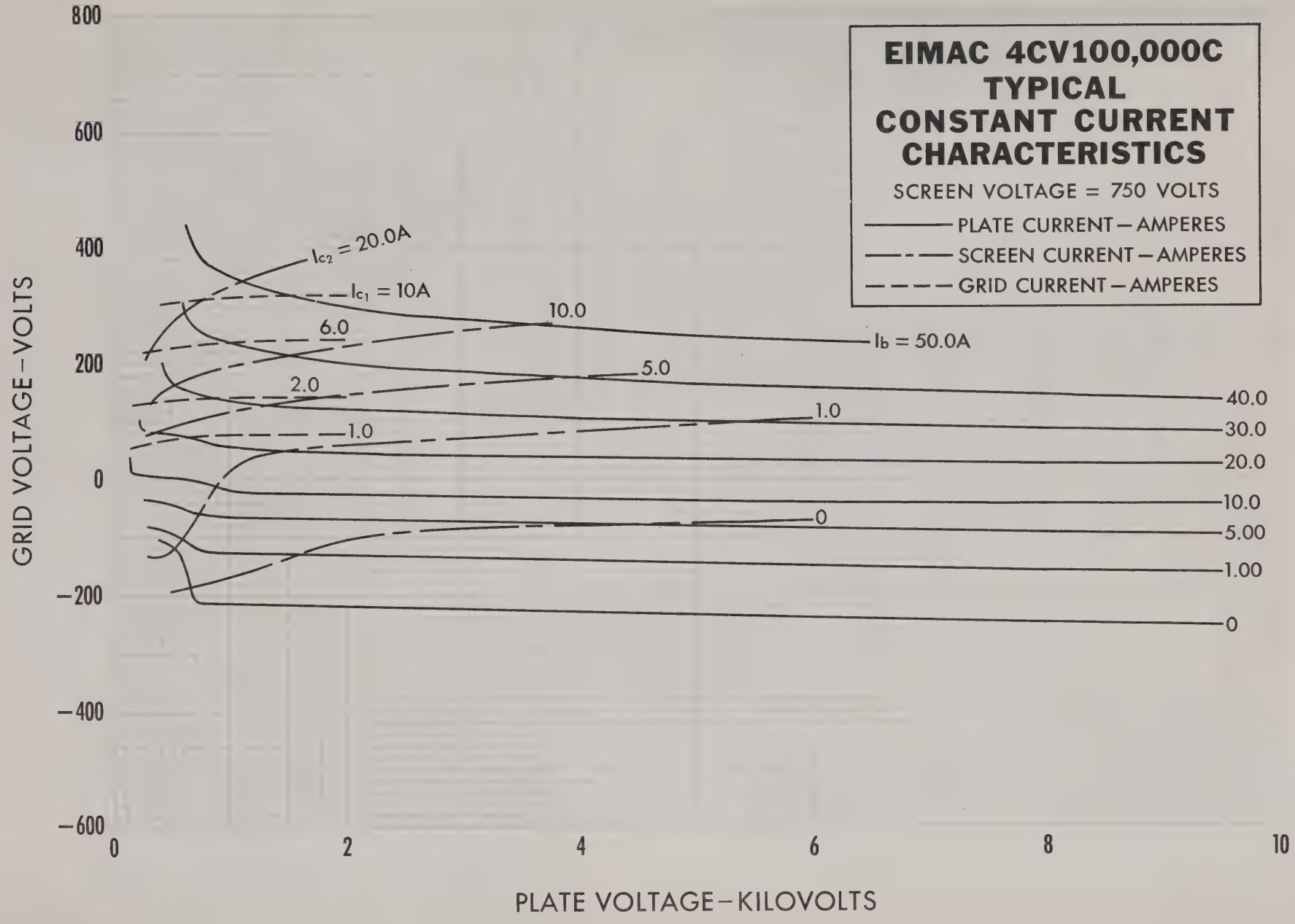
DC Plate Voltage	20,000	volts
DC Screen Voltage	1,500	volts
DC Grid Voltage*	-340	volts
Zero-Signal DC Plate Current	6.0	amps
Maximum-Signal DC Plate Current	18.8	amps
Maximum-Signal DC Screen Current	620	ma
Peak AF Driving Voltage (per tube)	330	volts
Driving Power	0	watts
Load Resistance, Plate-to-plate	2,500	ohms
Plate Dissipation (per tube)	58,000	watts
Maximum-Signal Plate Output Power	260,000	watts

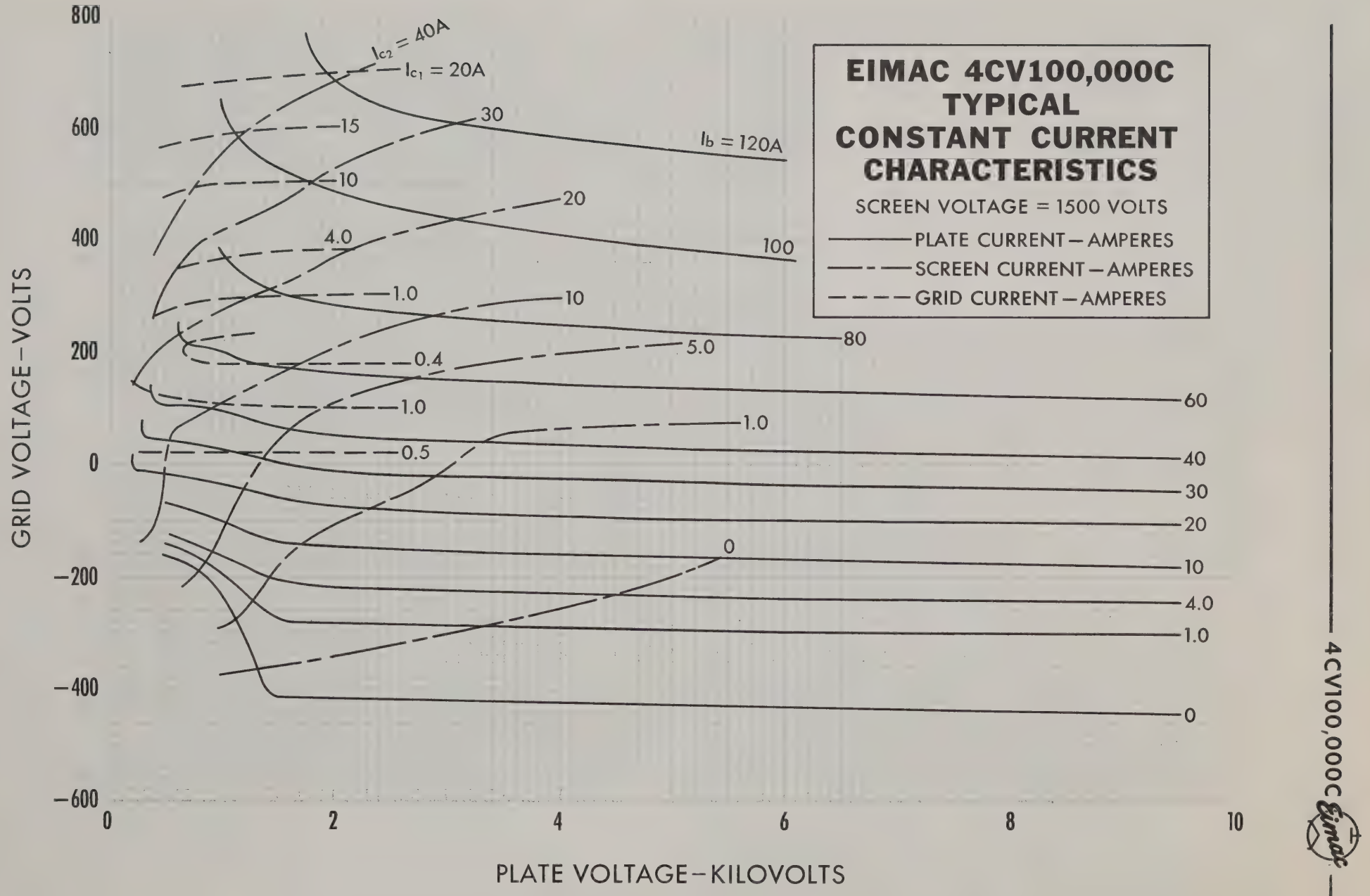
*Adjust grid voltage to obtain specified zero-signal plate current.



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM
A	8.480	8.520	
B	.860	.890	
C	4.980	5.020	
D	5.980	6.020	
E	5.940	6.062	
F	14.860	15.010	
G	16.660	17.000	
H	1.750	1.800	
J	6.250	6.500	
K	1.220	1.270	
L	.690	.740	
M	.188	.228	
N	.045	.075	
P	6.510	6.560	
R	6.980	7.020	
S	7.480	7.520	
T	485	.515	
U		.135	
V	7.975	8.015	
W	1.250	1.270	
X	.490	.530	
Y	9.990	10.010	


EIMAC 4CV100,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
I_{c_2} = 20.0A
I_{c_1} = 10A
I_b = 50.0A
10.0
6.0
5.0
2.0
1.0
1.0
0
40.0
30.0
20.0
10.0
5.00
1.00
0


EIMAC 4CV100,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
800
600
400
200
0
–200
–400
–600
0
2
4
6
8
10
I_{c_2} = 40A
I_{c_1} = 20A
I_b = 120A
15
30
10
20
4.0
100
1.0
10
80
0.4
5.0
60
1.0
1.0
0.5
40
30
20
0
10
4.0
1.0
0

8244
4CW2000A

CERAMIC
POWER TETRODE

The EIMAC 8244/4CW2000A is a ceramic/metal water cooled radial-beam tetrode with a rated maximum plate dissipation of 2000 watts. It is a low-voltage high current tube designed for Class AB1 rf linear amplifier or audio amplifier applications where its high gain may be used to advantage. It is also recommended for voltage or current regulator service. As a regulator, the maximum dc plate voltage rating is 6000 volts. The 8244/4CW2000A is the water-cooled version of the 8168/4CX1000A.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-coated Unipotential		
Heater Voltage	6.0 ± 0.3	V
Heater Current, at 6.0 volts	9.0	A
Transconductance (Average):		
I_b = 1.0 Adc, E_{c2} = 325 Vdc	37,000	μmhos
Amplification Factor (Average):		
Grid to Screen	3.8	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Cin	81.5	pF
Cout	11.8	pF
Cgp	0.015	pF
Frequency of Maximum Rating:		
CW	110	MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	5.69 in; 144.5 mm
Diameter	2.66 in; 67.6 mm
Net Weight	27 oz; 766 gm
Operating Position	Vertical
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Cooling	Water
Base	Special, breechlock terminal surfaces
Recommended Socket	EIMAC SK-800 Series

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RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB_1 or B (Single Side-Band Suppressed-Carrier Operation)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	2000	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	0	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2000	2500	3000	Vdc
Screen Voltage	325	325	325	Vdc
Grid Voltage[1]	-60	-60	-60	Vdc
Zero-Signal Plate Current	250	250	250	mAdc
Single-Tone Plate Current[2]	890	885	875	mAdc
Two-Tone Plate Current[2]	645	650	635	mAdc
Zero-Signal Screen Current[2]	8	6	5	mAdc
Single-Tone Screen Current[2]	35	35	35	mAdc
Two-Tone Screen Current[2]	10	8	8	mAdc
Plate Output Power	930	1300	1630	W

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB , Grid Driven, Sinusoidal Wave

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	2000	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	0	WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	2000	2500	3000	Vdc
Screen Voltage	325	325	325	Vdc
Grid Voltage[1]	-60	-60	-60	Vdc
Zero-Signal Plate Current	500	500	500	mAdc
Maximum-Signal Plate Current	1.78	1.77	1.75	Adc
Zero-Signal Screen Current[2]	16	12	10	mAdc
Maximum-Signal Screen Current[2]	70	70	70	mAdc
Plate Output Power	1860	2600	3260	W
Load Resistance (Plate to Plate)	2040	2850	3860	Ω

1. Adjust to give stated zero-signal plate current.
2. Approximate value.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	8.1	9.9	A
Cathode Warmup Time	3.0	---	Min.
Amplification Factor (g1 to g2)	3.2	4.5	---
Interelectrode Capacitance (grounded cathode connection)[1]			
Cin	75.0	88.0	pF
Cout	10.8	12.8	pF
Cgp	---	0.022	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

COOLING - Sufficient cooling must be provided for the anode and ceramic/metal seals to maintain operating temperatures below the rated maximum value of 250°C.

Anode cooling is accomplished by circulating water through the integral water jacket. The tabulation below lists the minimum water flow requirements for 50°C inlet water temperature.

Plate Dissipation (Watts)	Water Flow (gpm)	Pressure Drop (psi)
1000	1.0	1.0
2000	2.0	2.5

Water pressure should never exceed 50 psi and outgoing water temperature must be limited to 70°C.

At ambient temperatures of 25°C, or less, when mounted in an EIMAC SK-800B socket, the 4CW2000A does not require base cooling. At higher temperatures, however separate base cooling may be required.

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

SHOCK AND VIBRATION - The 4CW2000A has the same internal construction as the EIMAC 4CX1000A, and both are capable of operation under vibration conditions at 10 g to 500 Hz, or long-duration shock (11 milliseconds) of 50 g, with full rated voltages applied.

When environmental stress is anticipated, care must be taken in mounting of the tube and socket so there is sufficient support for the tube to prevent relative motion between tube and socket under stress conditions. The socket is not designed to provide sole support for the tube during shock or vibrational stress.

ELECTRICAL

HEATER - The rated heater voltage for the 4CW2000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

GRID OPERATION - The grid dissipation rating of the 4CW2000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it neccessary to avoid positive grid operation.

Although the average grid current rating is zero, peak grid currents of less than five milliamperes as read on a five milliampere meter may be permitted to flow for peak signal monitoring purposes.

SCREEN OPERATION - Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CW2000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CW2000A is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be main-

tained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen or cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

PLATE OPERATION - The maximum rated plate dissipation power is 2000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

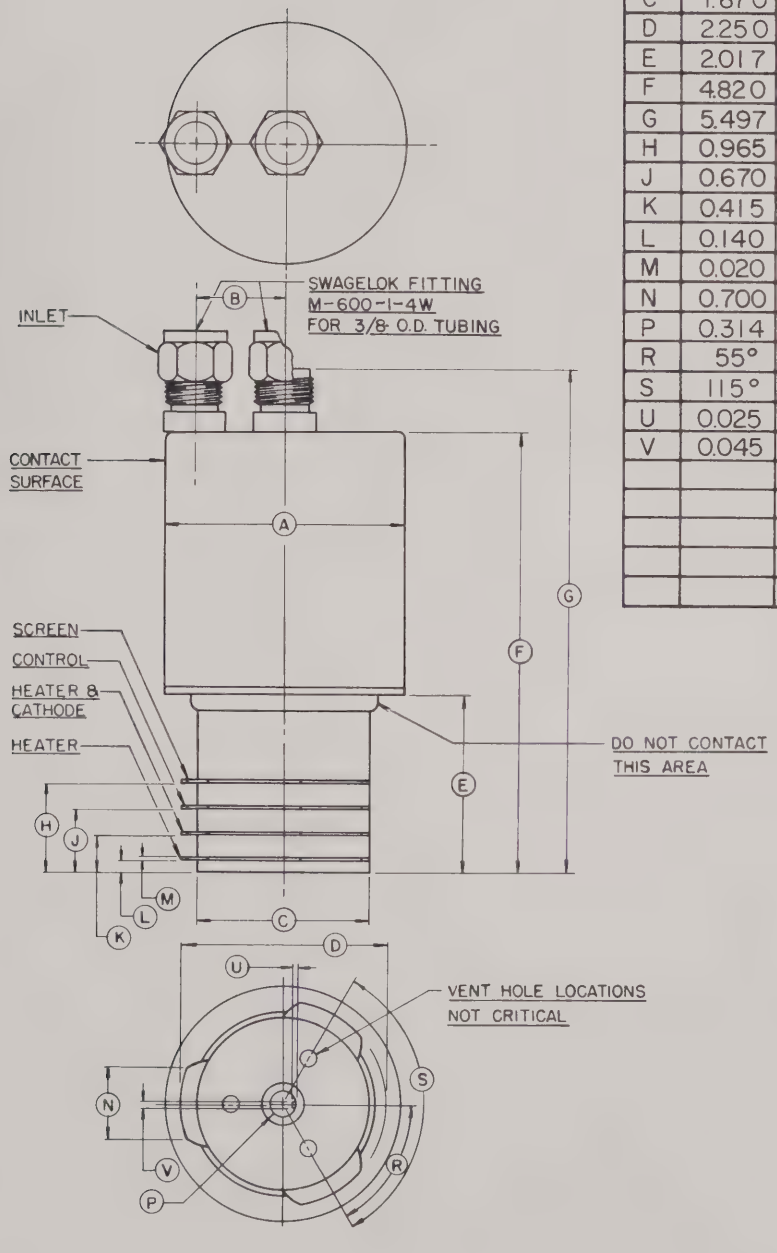
VOLTAGE OR CURRENT REGULATOR - The 4CW2000A is attractive for regulator service. As a voltage or current regulator the dc plate voltage rating is increased to 6000 volts. All other ratings remain the same.

HIGH VOLTAGE - The 4CW2000A operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

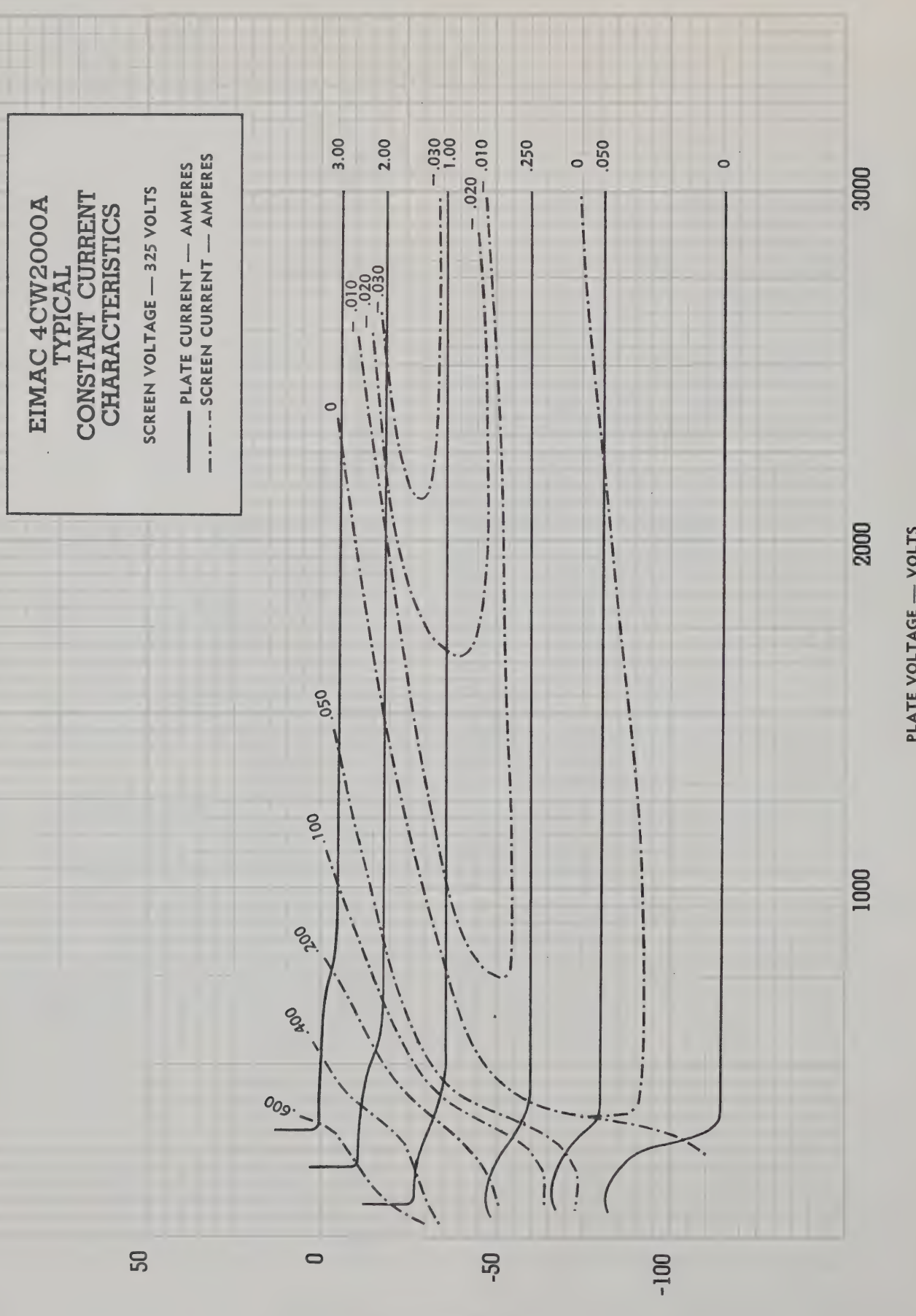
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions different from those given here, write to the Application Engineering Department, EIMAC Division of Varian, San Carlos, California, 94070, for information and recommendations.



DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	2.609	2.663	- -	66.27	66.88	- -
B	- -	- -	0.984	- -	- -	24.99
C	1.870	1.900	- -	47.50	48.26	- -
D	2.250	2.300	- -	57.15	58.42	- -
E	2.017	2.153	- -	51.23	54.69	- -
F	4.820	4.960	- -	122.43	125.98	- -
G	5.497	5.685	- -	139.62	144.40	- -
H	0.965	0.988	- -	24.51	25.10	- -
J	0.670	0.710	- -	17.02	18.03	- -
K	0.415	0.435	- -	10.54	11.05	- -
L	0.140	0.165	- -	3.56	4.19	- -
M	0.020	0.030	- -	0.51	0.76	- -
N	0.700	0.800	- -	17.78	20.32	- -
P	0.314	0.326	- -	7.98	8.28	- -
R	55°	65°	- -	55°	65°	- -
S	115°	125°	- -	115°	125°	- -
U	0.025	0.048	- -	0.64	1.22	- -
V	0.045	0.070	- -	1.14	1.78	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.


EIMAC 4CW2000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
3.00
2.00
1.00
.250
0
.050
0
.030
.020
.010
0
.010
.020
.030
.050
.100
.200
.400
.600
50
0
-50
-100
1000
2000
3000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

EIMAC
Division of Varian

8248
4PR250C

RADIAL-BEAM
PULSE TETRODE

The EIMAC 8248/4PR250C is a pulse tetrode intended for use in pulse-modulator, switch tube, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a tantalum plate and non-emitting grids, is recommended for use in new equipments where voltages to 50 kilovolts are required.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the EIMAC SK-410 Air-System Socket.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten

Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	14 A
Amplification Factor (Average):	
Grid to Screen	5.2
Direct Interelectrode Capacitances (grounded cathode)[2]	
Input	13.0 pF
Output	3.3 pF
Feedback	0.10 pF

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	7.63 in; 191.8 mm
Diameter	3.60 in; 91.3 mm
Net Weight	12.5 oz; 355 gm
Operating Position	Vertical, base down or up
Maximum Operating Temperature:	
Plate and Base Seals	200 °C
Cooling	Radiation and forced-air
Base	5-pin metal shell
Recommended Socket	EIMAC SK-410
Recommended Heat-Dissipating Connector :	
Plate	EIMAC HR-8

(Revised 9-1-70) © 1963, 1966 Varian

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PULSE MODULATOR SERVICE

MAXIMUM RATINGS:

DC PLATE VOLTAGE	50	KILOVOLTS
DC SCREEN VOLTAGE	2.0	KILOVOLTS
DC GRID VOLTAGE	-1.0	KILOVOLT
PEAK PLATE CURRENT [1]	4.0	AMPERES
PLATE DISSIPATION [2]	250	WATTS
SCREEN DISSIPATION [2]	25	WATTS
GRID DISSIPATION [2]	5	WATTS

1. In switch tube applications with capacitive loads, plate current may be increased to 6.0 amperes.
2. Average value.

TYPICAL OPERATION

Plate Voltage	30	40	50	kVdc
Screen Voltage	1.5	1.5	1.5	kVdc
Grid Voltage	-600	-650	-700	Vdc
Pulse Plate Voltage	28	38	48	kv
Peak Pulse Current	4.0	4.0	4.0	a
Pulse Screen Current	0.5	0.5	0.5	a
Pulse Grid Current	0.03	0.03	0.03	a
Pulse Input Power	120	160	200	kw
Pulse Output Power	112	152	192	kw
Pulse Drive Power	25	25	25	w
Pulse Positive Grid Voltage	130	130	130	v
Duty	3	3	3	%

RF POWER AMPLIFIER AND OSCILLATOR

Plate and Screen Pulsed

MAXIMUM RATINGS:

PEAK DC PLATE VOLTAGE	35	KILOVOLTS
DC SCREEN VOLTAGE	2.0	KILOVOLTS
DC GRID VOLTAGE	-1.0	KILOVOLT
PEAK CATHODE CURRENT [1]	5.5	AMPERES
PLATE DISSIPATION [2]	250	WATTS
SCREEN DISSIPATION [2]	25	WATTS
GRID DISSIPATION [2]	5	WATTS

1. The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the dc plate current component during the pulse.

TYPICAL OPERATION
Class C, Grounded filament

Plate Voltage (Pulsed)	25	30	35	kv
Screen Voltage (Pulsed)	1.5	1.5	1.5	kv
Grid Voltage	-650	-675	-700	Vdc
Pulse Plate Current [1]	940	925	900	ma
Pulse Screen Current	30	30	30	ma
Pulse Grid Current	6	6	6	ma
Peak Grid Voltage [3]	780	805	830	v
Pulse Driving Power [3]	4.7	5.0	4.5	w
Pulse Input Power	23.5	27.7	31.5	kw
Pulse Output Power	19.0	23.0	26.5	kw
Duty	5.5	5	5	%

2. Average value.
3. When used as a rf plate and screen-pulsed amplifier, the grid drive must also be pulsed to avoid overheating this element during the interpulse period.

RF POWER AMPLIFIER AND OSCILLATOR

Grid Pulsed

MAXIMUM RATINGS:

DC PLATE VOLTAGE	25	KILOVOLTS
DC SCREEN VOLTAGE	2.0	KILOVOLTS
DC GRID VOLTAGE	-1.0	KILOVOLTS
PEAK CATHODE CURRENT [1]	5.5	AMPERES
PLATE DISSIPATION [2]	250	WATTS
SCREEN DISSIPATION [2]	25	WATTS
GRID DISSIPATION [2]	10	WATTS

1. The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the dc plate current component during the pulse.

TYPICAL OPERATION

Plate Voltage	20	25	kVdc
Screen Voltage	1.5	1.5	kVdc
Grid Voltage	-600	-650	Vdc
Peak Grid Voltage (Pulsed)	730	780	v
Pulse Plate Current [1]	940	940	ma
Pulse Screen Current	30	30	ma
Pulse Grid Current	6	6	ma
Pulse Driving Power	4.4	4.7	w
Pulse Input Power	18.8	23.5	kw
Pulse Output Power	15.0	19.0	kw
Duty	6	5.5	%

2. Average Value.
3. When used as a rf plate and screen-pulsed amplifier, the grid drive must also be pulsed to avoid overheating this element during the interpulse period.

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves. Adjustment of the grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Filament: Current at 5.0 volts	13.5	14.7	A
Interelectrode Capacitances [1] (grounded filament connection)			
Input	11.0	15.0	pF
Output	2.5	4.0	pF
Feedback		0.15	pF

1. In shielded fixture.

APPLICATION

MECHANICAL

MOUNTING - The 4PR250C must be operated vertically base up or down. The SK-410 Air-System Socket may be used to aid in directing air to the metal base shell.

In the event the SK-410 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers. The tube must be protected from severe shock and vibration.

COOLING - Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 200°C. In all classes of operation it is recommended that a heat-radiating connector, the EIMAC HR-8 or equivalent, be installed on the anode terminal, and that a socket be employed which provides for proper base seal cooling. When the EIMAC 4PR250C is operated at dc or low frequencies in an EIMAC SK-410 Air System Socket, the minimum airflow requirements to maintain seal temperatures at 200°C in 25°C inlet air are approximately 2 to 5 cfm.

When the EIMAC 4PR250C is used as a pulsed-amplifier or oscillator at frequencies above 30 MHz, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by rf charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured by using a temperature-sensitive paint.

ELECTRICAL

FILAMENT VOLTAGE - For maximum tube life the filament voltage, as measured directly at the filament pins, should be 5.0 volts. Variations in filament voltage must be kept within the range of 4.75 to 5.25 volts.

When the 4PR250C is used in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

ELEMENT DISSIPATION - Under normal operating conditions, the average plate dissipation of the 4PR250C should not be allowed to exceed 250 watts. Dissipation in excess of this maximum rating is permissible for short periods of time, such as during tuning procedures.

The average power dissipated by the screen-grid and the control-grid must not exceed 25 watts and 5 watts, respectively.

CUT-OFF CHARACTERISTICS - The plate current cut-off characteristics of the 4PR250C are shown in the following graph. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristic closely approximate the mean value in the tube test specification.

Each 4PR250C is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 50 kV, a screen voltage of 1.5 kV, with the grid voltage adjusted to maintain a plate current of

10 microamperes. Under these test conditions the negative grid bias must not exceed 675 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between –500 volts and –650 volts.

PULSE-MODULATOR SERVICE-The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate wave form is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

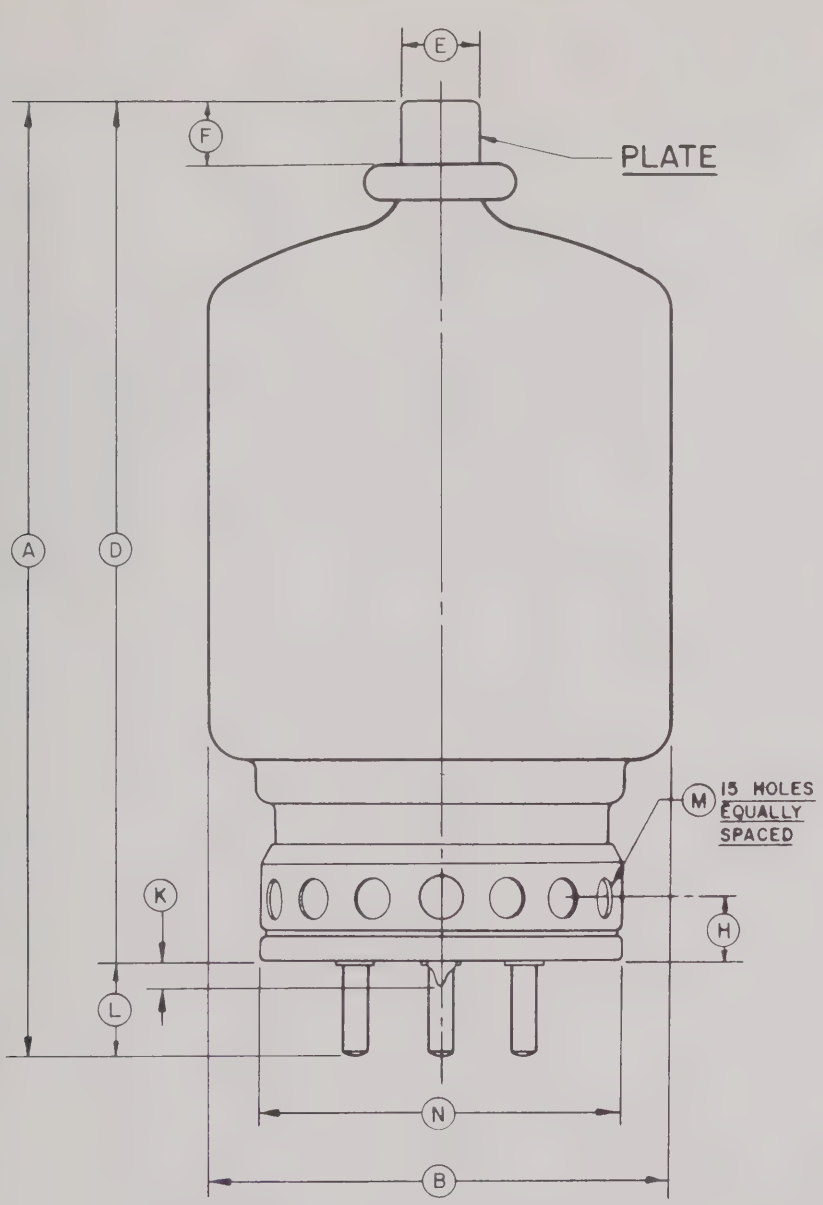
As a switch tube with capacitive loading, as in a floating deck modulator, the peak plate current during the pulse may reach 6.0 amperes. This can be tolerated since under capacitive load conditions the plate voltage at the beginning of the pulse is equal to applied dc voltage, with high plate current and low screen grid current. As the load is charged, plate current falls while screen current rises. Protection for the screen must be provided to limit dissipation at the end of the pulse.

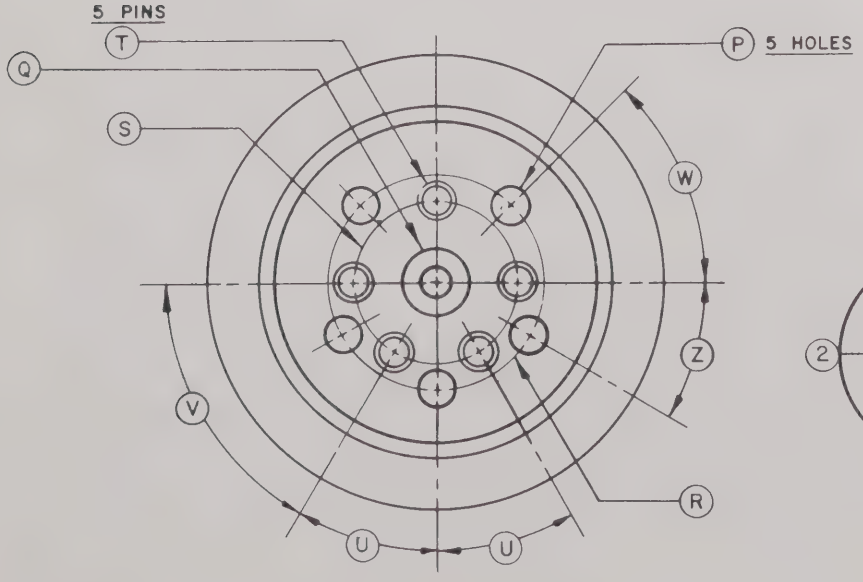
X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased, and are therefore potential X-ray hazards. Very little shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly on older tubes with aging and gradual deterioration, due to leakage paths or emission characteristics as they are effected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. When pulse transformers are involved, shielding may also be required for these. Periodic checks on the X-ray level should be made, and such tubes must never be operated without shielding in place. Lead glass which attenuates X-rays is available for viewing windows. If there is any doubt as to the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment. Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

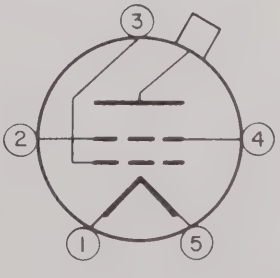
Reference: MEDICAL X-RAY PROTECTION UP TO THREE MILLION VOLTS, National Bureau of Standards Handbook 76. Available from Superintendent of Documents, Washington, DC 20402. Price: 25 cents.
NCRP REPORT #33-MEDICAL X-RAY AND GAMMA RAY PROTECTION FOR ENERGIES UP TO 10 MEV. Available from N.C.R.P. Publications, P.O. Box 4867, Washington, DC 20008. Price: 75 cents.

HIGH VOLTAGE - The 4PR250C operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SPECIAL APPLICATIONS-If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

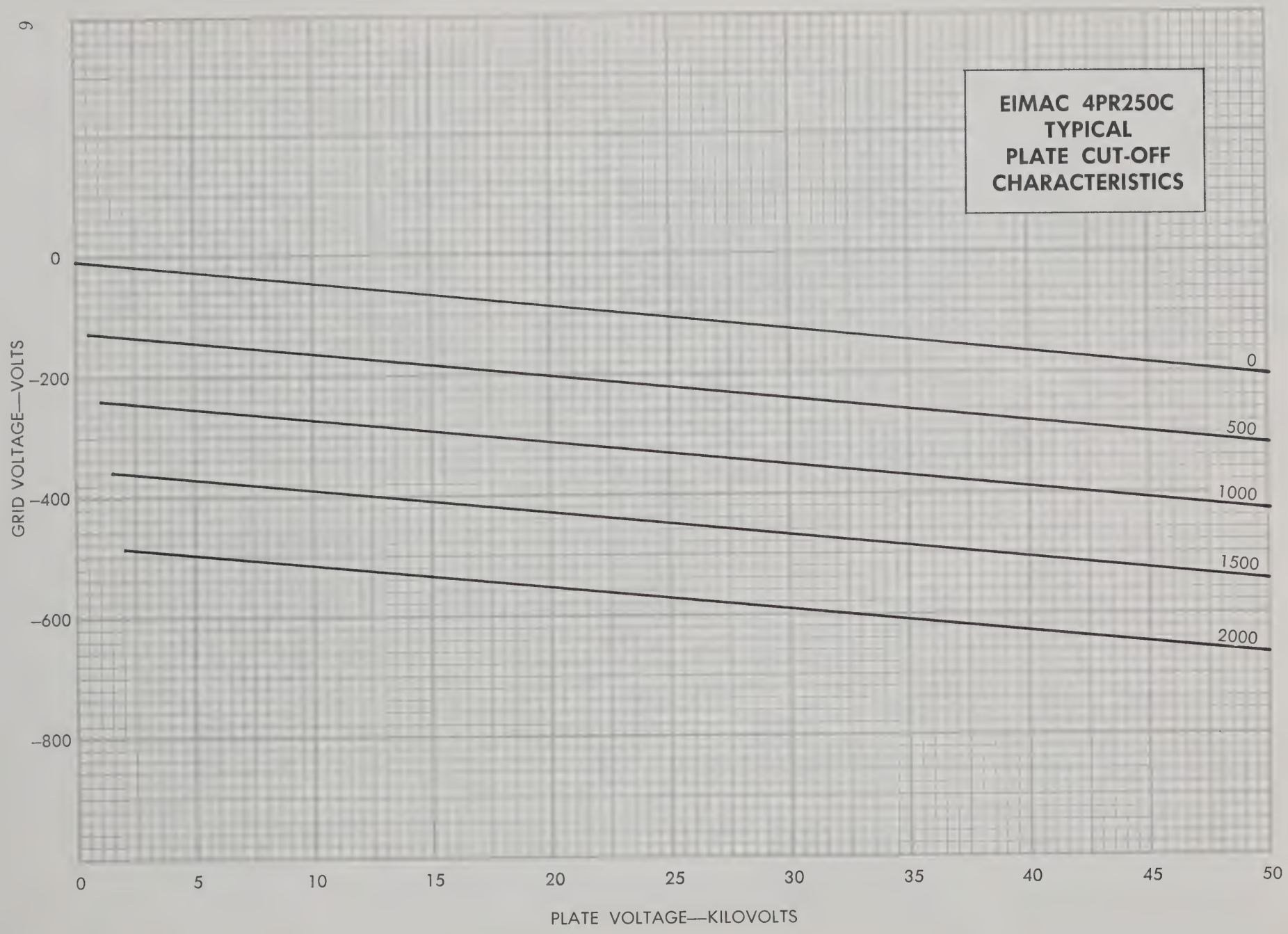


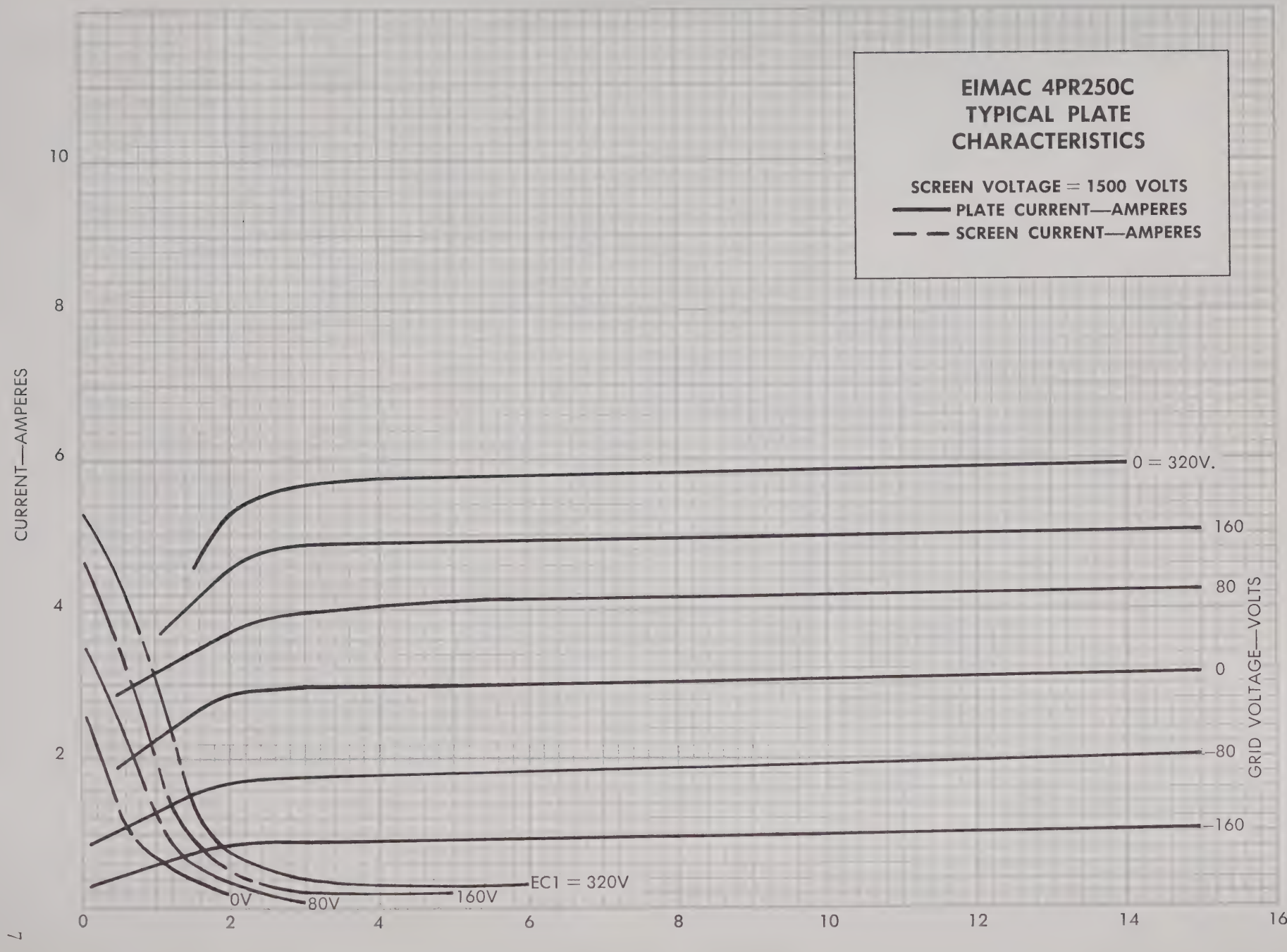


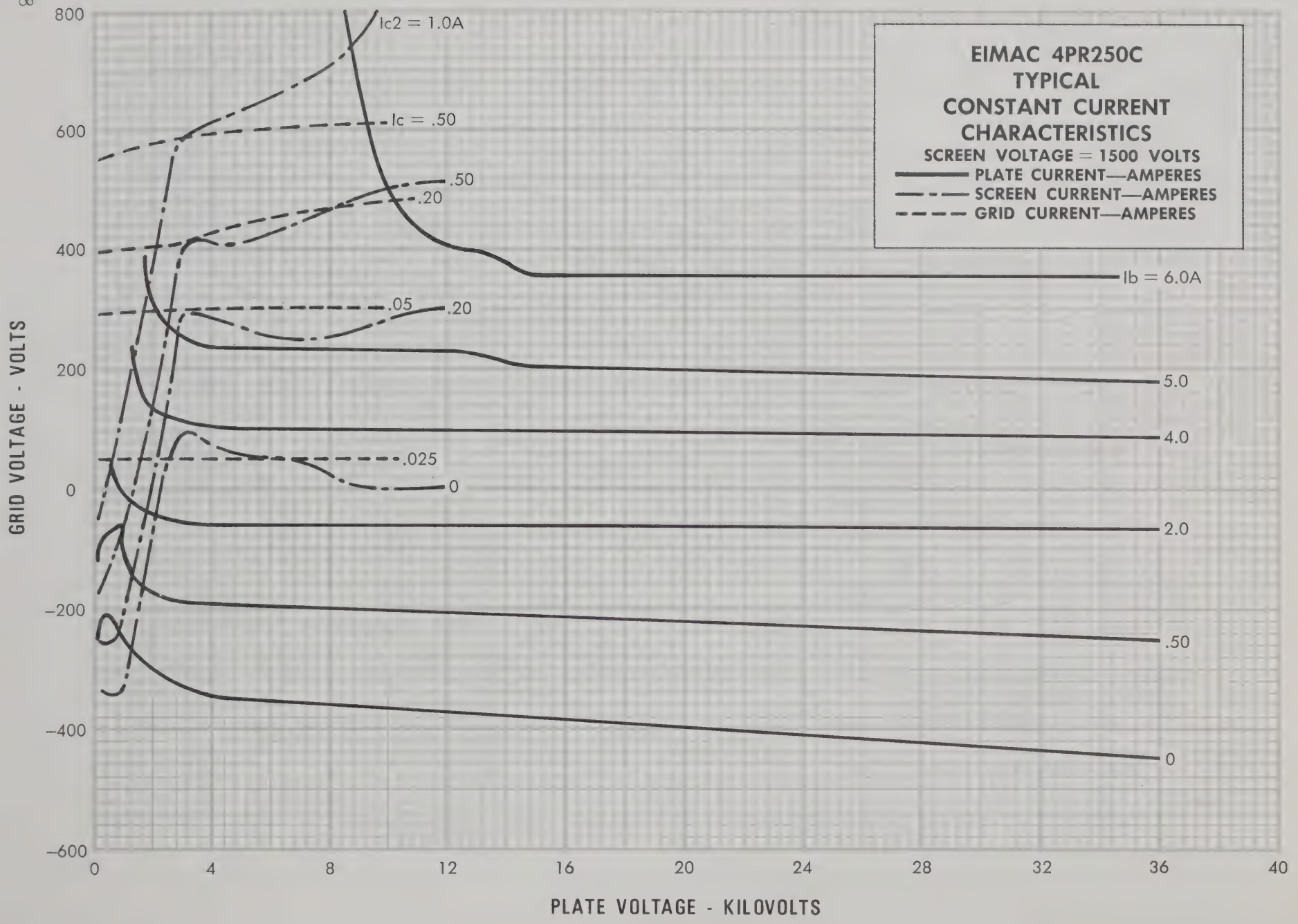


DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	7.062	7.625	179.37	193.68
B	3.406	3.594	86.51	91.29
D	6.313	6.813	160.35	173.05
E	0.557D	0.567D	14.15	14.40
F	0.469	0.531	11.91	13.49
H	0.375	0.500	9.53	12.70
K	0.250 (NOTE 1)		6.35 (NOTE 1)	
L	0.688	0.875	17.48	22.23
M	0.219D	0.281D	5.57	7.14
N	--	2.750	--	69.86
P	0.281	0.344	7.14	8.74
Q	0.469	0.531	12.60	13.49
R	1.594	1.656	40.49	42.06
S	0.250 (NOTE 1)		6.35 (NOTE 1)	
T	0.185D	0.191D(1)	4.70D	4.85(1)
U	30° (NOTE 1)		30° (NOTE 1)	
V	60° (NOTE 1)		60° (NOTE 1)	
W	45° (NOTE 1)		45° (NOTE 1)	
Z	30° (NOTE 1)		30° (NOTE 1)	

NOTES:
BASE PINS (T) AND TUBULATION (K) MUST BE ALIGNED SO THAT THEY CAN BE FREELY INSERTED IN A GAUGE 1/4" THICK WITH HOLE DIAMETERS OF .204 & .500 FOR PINS AND TUBULATION RESPECTIVELY LOCATED ON TRUE CENTERS DEFINED BY (S) (U) (V).


EIMAC 4PR250C
TYPICAL
PLATE CUT-OFF
CHARACTERISTICS
GRID VOLTAGE—VOLTS
0
−200
−400
−600
−800
0
500
1000
1500
2000
SCREEN VOLTAGE—VOLTS
0
5
10
15
20
25
30
35
40
45
50
PLATE VOLTAGE—KILOVOLTS


EIMAC 4PR250C
TYPICAL PLATE
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
CURRENT—AMPERES
PLATE VOLTAGE/KILOVOLTS
GRID VOLTAGE—VOLTS
0 = 320V.
160
80
0
-80
-160
EC1 = 320V
0V
80V
160V
0
2
4
6
8
10
12
14
16


EIMAC 4PR250C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
Ic2 = 1.0A
Ic = .50
.50
.20
.05
.20
.025
0
Ib = 6.0A
5.0
4.0
2.0
.50
0
800
600
400
200
0
−200
−400
−600
0
4
8
12
16
20
24
28
32
36
40
GRID VOLTAGE - VOLTS
PLATE VOLTAGE - KILOVOLTS

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8249
4W300B

RADIAL BEAM
POWER TETRODE

The EIMAC 8249/4W300B is a ceramic/metal, water cooled, external-anode radial-beam tetrode with a maximum plate dissipation rating of 300 watts and a maximum power input rating of 500 watts. The 8249/4W300B is designed to operate with a heater voltage of 6.0 volts. Electrically identical to the 4CX250B, it is intended for use where water cooling is preferred or where reserve anode dissipation is desired.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	2.6	A
Cathode - Heater Potential	±150	V
Transconductance (Average):		
I_b = 200 mAdc	12,000	μmhos
Amplification Factor (Average):		
Grid to Screen	5.0	
Direct Interelectrode Capacitance (grounded cathode)[2]		
Input	15.7	pF
Output	4.5	pF
Feedback	0.04	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Input	13.0	pF
Output	4.5	pF
Feedback	0.01	pF
Frequency of Maximum Rating:		
CW	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	3.407 in; 86.54 mm
Diameter	1.562 in; 39.67 mm
Net Weight	5.75 oz; 163.0 gm
Operating Position	Vertical, base up or down

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Maximum Operating Temperature:
Ceramic/Metal Seals . . . . . 250°C
Cooling . . . . . Water and forced air
Base . . . . . Special 9-pin JEDEC-B8-236
Recommended Air System Socket . . . . . SK-600 series

MAXIMUM RATINGS:	Class C Plate Mod	Class C CW or FM	Class AB Audio or SSB	
DC PLATE VOLTAGE . . .	1500	2000	2000	VOLTS
DC SCREEN VOLTAGE . .	300	300	400	VOLTS
DC GRID VOLTAGE . . .	-250	-250	-250	VOLTS
DC PLATE CURRENT . . .	0.20	0.25	0.25	AMPERE
PLATE DISSIPATION . . .	200	300	300	WATTS
SCREEN DISSIPATION . .	12	12	12	WATTS
GRID DISSIPATION . . .	2	2	2	WATTS

TYPICAL OPERATION:	DC Plate Voltage (Volts)	Power Input (Watts)	Driving Power (Watts)	Power Output (Watts)
CLASS C AMPLIFIER				
CW or FM	2000	500	3	390
Plate Modulated	1500	300	2	235
CLASS AB_1 AMPLIFIER				
Audio (Two tubes)	2000	1000	0	600
SSB (One tube)	2000	500	0	300

For full listing of ratings, constant current curves and typical operating conditions, see EIMAC data sheet for 7203/4CX250B.

RANGE VALUES FOR EQUIPMENT DESIGN

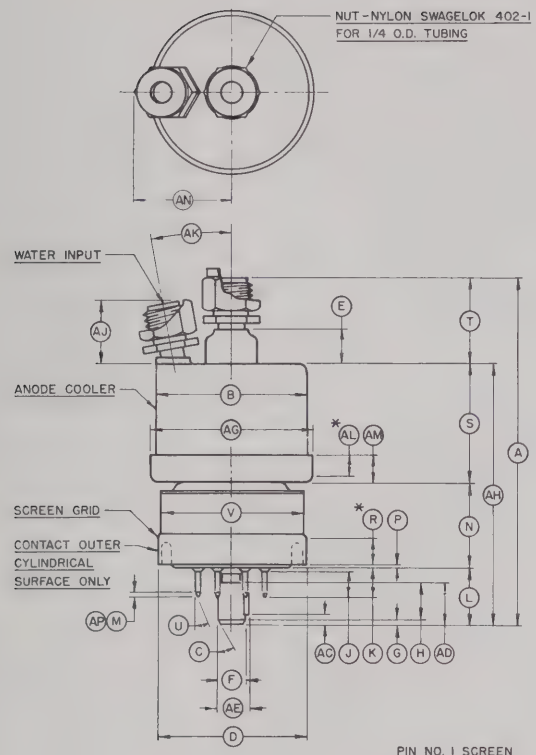
Heater: Current at 6.0 volts	2.3	2.9	A
Cathode Warmup Time	30	--	sec.
Interelectrode Capacitances[1] (grounded cathode connection)			
Input	14.2	17.2	pF
Output	4.0	5.0	pF
Feedback	---	0.60	pF

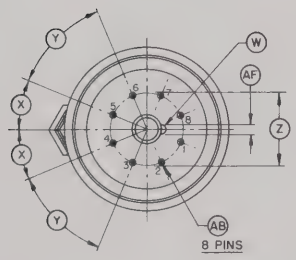
1. Capacitance values are for a cold tube as measured in a shielded fixture.

APPLICATION

COOLING - The water-cooled anode requires a minimum of 1/16 gallon of cooling water per minute for the rated plate dissipation of 300 watts. The outlet-water temperature should not exceed 70°C and the system pressure should not exceed 50 pounds per square inch.

The ceramic/metal seals must be cooled by forced air. At frequencies below 30 MHz and when one of the recommended sockets is used, a flow rate of 1.0 CFM is sufficient. As the operating frequency is increased, the air-flow rate must be increased. At 500 MHz a minimum of 3.8 CFM is required. In all cases, seal temperatures are the criteria which determine cooline effectiveness.





PIN NO. 1 SCREEN
PIN NO. 2 CATHODE
PIN NO. 3 HEATER
PIN NO. 4 CATHODE
PIN NO. 5 I.C. (DO NOT USE FOR EXTERNAL CONN.)
PIN NO. 6 CATHODE
PIN NO. 7 HEATER
PIN NO. 8 CATHODE
CENTER PIN - CONTROL GRID

NOTES:
1. DIMENSIONS IN INCHES.
2. (*) LENGTH AVAILABLE FOR CONTACT.

DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN.	MAX	REF
A	– –	3.407	– –	– –	86.54	– –
B	– –	1.490	– –	– –	37.85	– –
C	– –	– –	30°	– –	– –	30°
D	1.417	1.433	– –	36.00	36.40	– –
E	– –	– –	0.244	– –	– –	6.20
F	0.255	0.265	– –	6.48	6.73	– –
G	– –	– –	0.031	– –	– –	0.79
H	0.360	– –	– –	9.14	– –	– –
J	0.187	– –	– –	4.75	– –	– –
K	– –	0.250	– –	– –	6.35	– –
L	0.514	0.554	– –	13.06	14.07	– –
M	– –	– –	0.035	– –	– –	0.89
N	0.750	0.810	– –	19.05	20.57	– –
P	– –	– –	0.020	– –	– –	0.51
R	0.187	– –	– –	4.75	– –	– –
S	1.106	1.186	– –	28.09	30.12	– –
T	0.797	0.857	– –	20.24	21.77	– –
U	– –	– –	22.5°	– –	– –	22.5°
V	– –	1.406	– –	– –	35.71	– –
W	– –	0.043R	– –	– –	1.09 R	– –
X	– –	– –	22.5°	– –	– –	22.5°
Y	– –	– –	45°	– –	– –	45°
Z	0.680	0.694	– –	17.27	17.63	– –

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

4CX1500A

TECHNICAL DATA

RADIAL BEAM TETRODE

The EIMAC 4CX1500A is a general purpose tetrode for use up to and through VHF. Insulation is ceramic and the thoriated tungsten filament is a rugged mesh design. The screen terminal is a continuous ring which allows good isolation between the plate circuit and the control grid circuit.



The 4CX1500A is recommended for use as a class C power amplifier, class B, or class AB_1 linear amplifier, as a regulator, and in pulse modulator service.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament Voltage	5.0	volts
Filament Current	38.5	amps
Amplification Factor (Grid Screen)	5.5	
Transconductance (I_b = 1 ampere)		
E_{c_2} = 500 volts, E_b = 200 volts)	26,000	μmho
Frequency for Maximum Ratings	150	MHz
Direct Interelectrode Capacitances (Grounded Cathode) [2]		
Cin	78.0	pF
Cout	10.5	pF
Cgp	0.25	pF

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special ring and breechblock terminal surfaces
Recommended Socket	EIMAC SK-831
Recommended Air Chimney	EIMAC SK-806
Operating Position	Axis Vertical
Maximum Anode Core Temperature	250°C
Maximum Seal Temperature	250°C
Cooling	Forced Air

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Maximum Dimensions	
Height	4.90 in; 124.5 mm
Diameter	3.37 in; 85.6 mm
Net Weight	30 oz; 850 gm
Shipping Weight (Approximately)	3 lb; 1.21 kg

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.
Filament Current, E_f = 5.0 V	36.5	40.5 A
Interelectrode Capacitance (grounded cathode circuit) [1]		
Cin	73.0	83.0 pF
Cout	8.5	12.5 pF
Cgp	---	0.4 pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC PLATE CURRENT	1.0 AMPERE
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	75 WATTS
CONTROL GRID DISSIPATION	25 WATTS

TYPICAL OPERATION Class AB_1

DC Plate Voltage	2500	3900 V
DC Screen Voltage	600	600 V
DC Grid Voltage [1]	-105	-110 V
Zero-Signal Plate Current	250	200 mA
Max-Signal Plate Current	765	750 mA
Max-Signal Screen Current [2]	46	40 mA
Peak RF Driving Voltage	95	100 v
Resonant Plate Load Resistance	1670	2900 Ω
Max-Signal Plate Power Out	1080	1850 W

1. Adjust to specified zero-signal dc plate current.
2. Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM
(Continuous Operating Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	5000 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC PLATE CURRENT	1.0 AMPERE
PLATE DISSIPATION	1500 WATTS
SCREEN DISSIPATION	75 WATTS
CONTROL GRID DISSIPATION	25 WATTS

TYPICAL OPERATION

	Low Freq. Calculated		220 MHz Measured
DC Plate Voltage	3000	4000	3000 V
DC Screen Voltage	500	500	500 V
DC Grid Voltage	-200	-200	-116 V
DC Plate Current	800	800	1000 mA
DC Screen Current [2]	36	37	35 mA
DC Grid Current [2]	17	15	0 mA
Peak RF Grid Voltage	240	240	--- v
Driving Power	4.1	3.6	31.5 W
Resonant Load Resistance	1720	2570	--- Ω
Plate Dissipation	600	700	--- W
Power Output	1800	2500	1500 W [1]

1. Useful Power Output
2. Approximate values.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class C Telephony
(Carrier Conditions unless noted)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3500	VOLTS
DC SCREEN VOLTAGE	550	VOLTS
DC PLATE CURRENT	.8	AMPERE
PLATE DISSIPATION [1]	1000	WATTS
SCREEN DISSIPATION	75	WATTS
CONTROL GRID DISSIPATION	25	WATTS

1. Corresponds to 1500 watts at 100% sine-wave modulation.

TYPICAL OPERATION

	Low Frequency Calculated		
DC Plate Voltage	2500	3400	V
DC Screen Voltage	500	500	V
DC Grid Voltage	-300	-300	V
Peak Audio Screen Voltage (For 100% mod. approx.)	500	500	v
DC Plate Current	800	900	mA
DC Screen Current [2]	46	28	mA
DC Grid Current [2]	27	28	mA
Peak RF Grid Voltage	365	365	v
Grid Driving Power	10	10	W
Resonant Load Resonant	3200	1940	Ω
Plate Dissipation	620	780	W
Plate Power Out	1600	2320	W

2. Approximate value.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class AB

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	750	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
SCREEN DISSIPATION	75	WATTS
CONTROL GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Two Tubes) Class AB_1

DC Plate Voltage	2500	3900	V
DC Screen Voltage	600	600	V
DC Grid Voltage	-105	-110	V
Zero-Signal Plate Current	500	400	mA
Max-Signal Plate Current	1.530	1.500	A
Max-Signal Screen Current [2]	90	80	mA
Peak AF Driving Voltage	95	100	v
Load Resistance Plate to Plate	3340	5800	Ω
Max-Signal Plate Dissipation [1]	820	1070	W
Max-Signal Plate Power Out	2160	3700	W

1. Per Tube
2. Approximate value.

NOTE: TYPICAL OPERATION data is obtained by direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias screen and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In Class C service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

APPLICATION

MECHANICAL

MOUNTING - The 4CX1500A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC SK-831 socket and SK-806 chimney have been designed especially for the 4CX1500A. The use of recommended air-flow rates through these sockets provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through the Air Chimney, and through the anode cooling fins.

COOLING - The maximum temperature rating for the anode core of the 4CX1500A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated on page 4 (for operation below 30 MHz).

	SEA LEVEL		6000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
1000	27	0.33	33	0.40
1500	47	0.76	58	0.95

*Since the power dissipated by the filament represents about 200 watts and since grid-plus-screen dissipation can, under some conditions, represent another 100 watts, allowance has been made in preparing this tabulation for an additional 300 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 4CX1500A is 5.0 volts. Filament voltage, as measured at the socket, should be maintained at this value or below to obtain maximum tube life.

CONTROL GRID OPERATION - The rated dissipation of the grid is 25 watts. This is approximately the product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

SCREEN GRID OPERATION - The power dissipated by the screen of the 4CX1500A must not exceed 75 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon RMS screen current and voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 75 watts in the event of circuit failure.

HIGH VOLTAGE - Normal operating voltages used with the 4CX1500A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

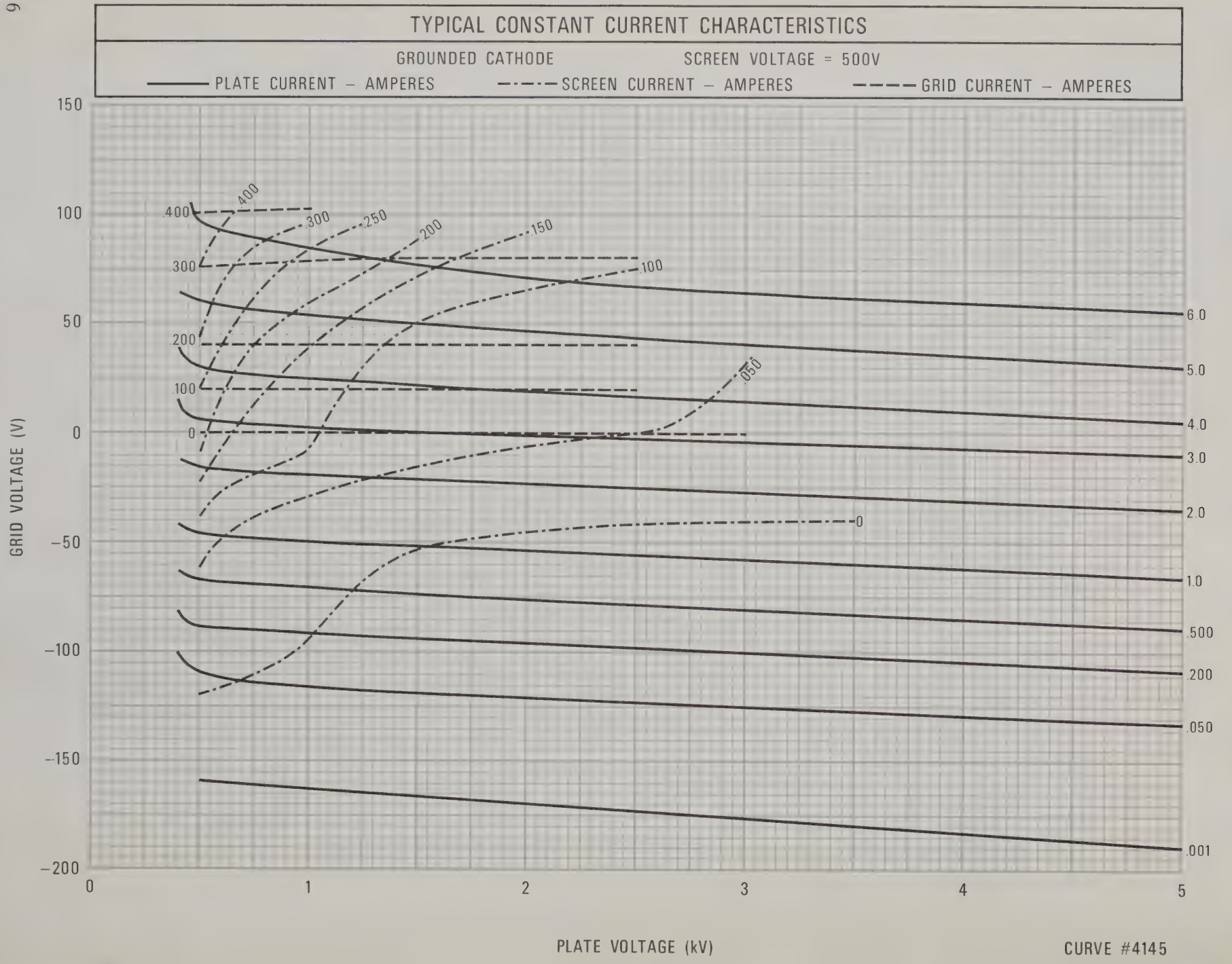
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground".

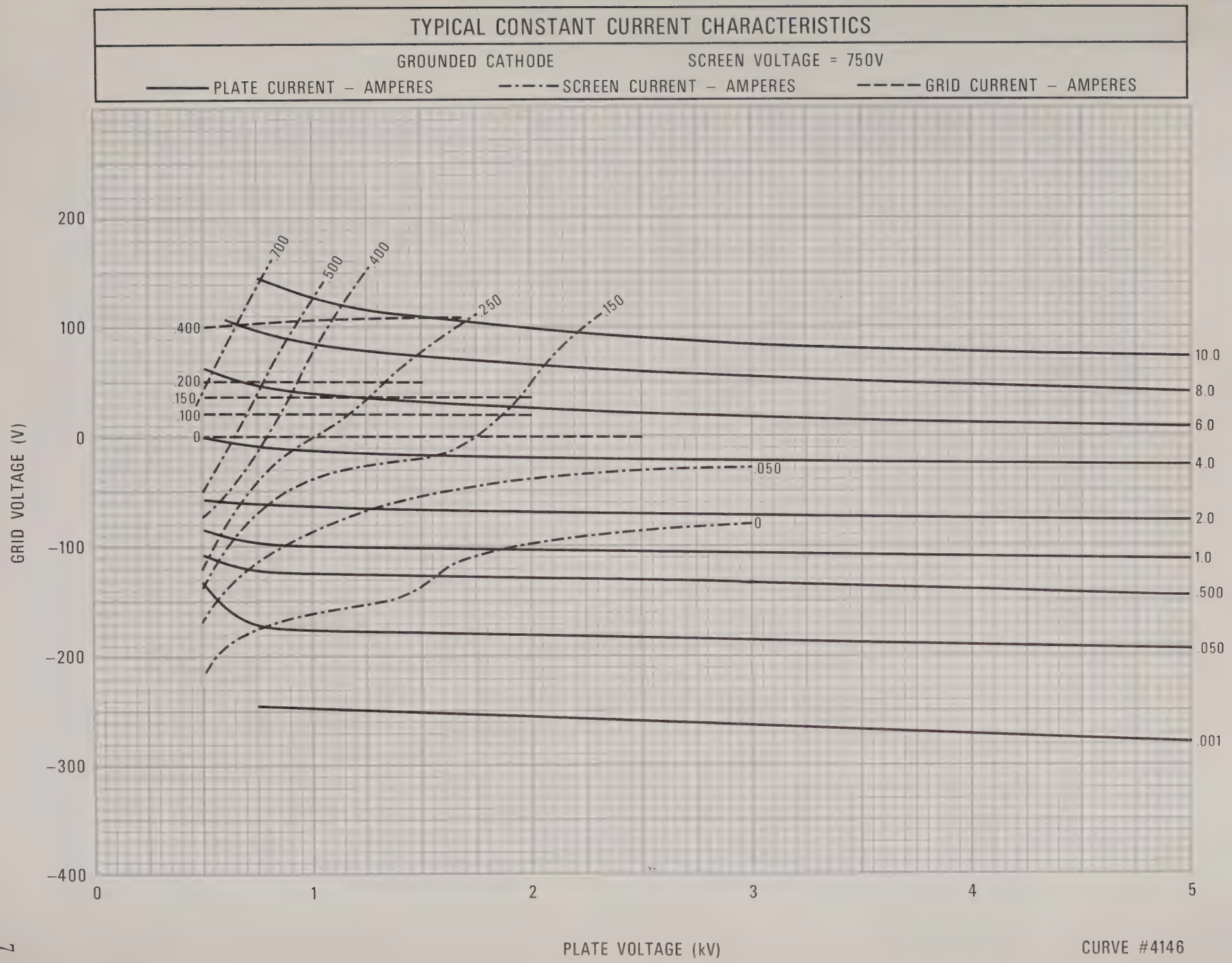
The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

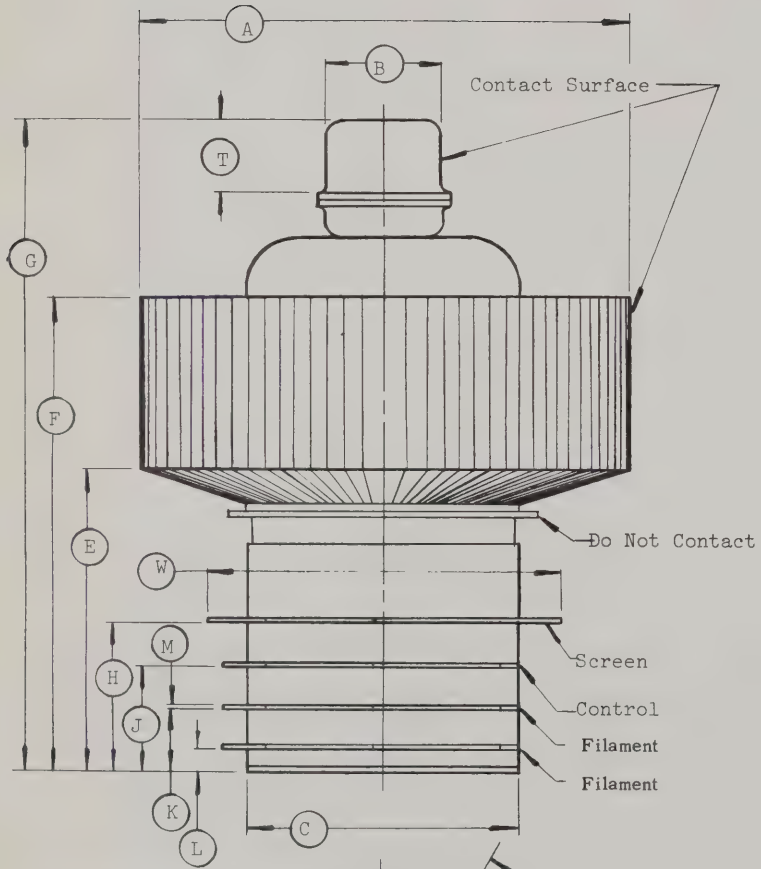
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

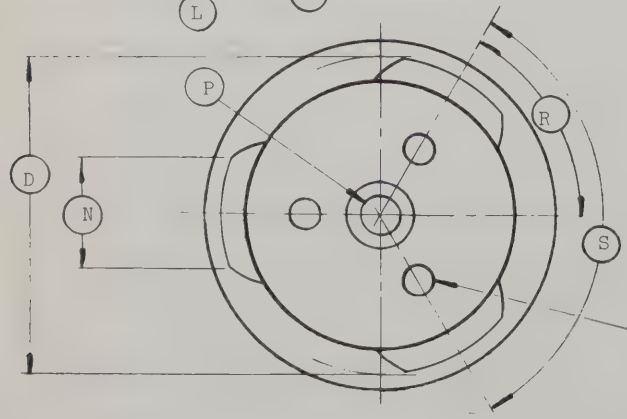
MULTIPLE OPERATION - To obtain maximum power output with minimum distortion from tubes operated in multiple, it is desirable to adjust individual screen or grid bias voltages so that the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual dc plate currents will be approximately equal for full input signal.

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
150
100
50
0
−50
−100
−150
−200
0
1
2
3
4
5
PLATE VOLTAGE (kV)
400
300
250
200
150
100
050
0
400
300
200
100
0
6.0
5.0
4.0
3.0
2.0
1.0
.500
.200
.050
.001
CURVE #4145


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 750V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
200
100
0
–100
–200
–300
–400
0
1
2
3
4
5
PLATE VOLTAGE (kV)
.700
.500
.400
.250
.150
.400
.200
.150
.100
0
.050
0
10.0
8.0
6.0
4.0
2.0
1.0
.500
.050
.001
CURVE #4146





DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	3.335	3.370	- -	84.71	85.60	- -
B	0.807	0.820	- -	20.50	20.83	- -
C	1.865	1.900	- -	47.37	48.26	- -
D	2.250	2.300	- -	57.15	58.42	- -
E	2.265	2.465	- -	57.53	62.61	- -
F	3.454	3.654	- -	87.73	92.81	- -
G	4.675	4.900	- -	118.74	124.46	- -
H	0.965	0.988	- -	24.51	25.09	- -
J	0.690	0.710	- -	17.53	18.03	- -
K	0.415	0.435	- -	10.54	11.05	- -
L	0.140	0.165	- -	3.56	4.19	- -
M	0.018	0.030	- -	00.46	0.76	- -
N	0.700	0.800	- -	17.78	20.32	- -
P	0.314	0.326	- -	7.97	8.28	- -
R	55°	65°	- -	55°	65°	- -
S	115°	125°	- -	115°	125°	- -
T	0.470	0.530	- -	11.94	13.46	- -
W	2.468	2.531	- -	62.69	64.29	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

TECHNICAL DATA

8171
4CX10,000D

RADIAL-BEAM
POWER TETRODE

The EIMAC 8171/4CX10,000D is a ceramic/metal tetrode which is identical electrically to the 8170/4CX5000A except for its rated plate dissipation. Its increased dissipation capability, resulting from a larger cooler, is most useful in linear applications where plate dissipation is generally the limiting factor.

The larger cooler also allows the 8171/4CX10,000D to be used in place of the 8170/4CX5000A with less cooling for any given plate dissipation, or results in cooler operation at any given air-flow rate.

The 8171/4CX10,000D is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megahertz and is particularly suited for use as a linear rf amplifier or class-AB_1 audio amplifier.

A pair of these tubes, operating class-AB_1, will deliver more than 30 kilowatts of audio-frequency or radio-frequency plate output power.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 ± 0.37 V
Current, at 7.5 volts	75 A
Amplification Factor (Grid Screen), Average	4.5
Direct Interelectrode Capacitances, Grounded Cathode: [2]	
Cin	115 pF
Cout	20.5 pF
Cgp	0.7 pF
Direct Interelectrode Capacitances, Grounded Grid: [2]	
Cin	53 pF
Cout	20.5 pF
Cpk	0.10 pF

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special concentric
Maximum Seal Temperature	250 °C
Maximum Anode-Core Temperature	250 °C
Recommended Socket	EIMAC SK-300A

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Recommended Air Chimney	EIMAC SK-1306
Operating Position	Axis vertical, base up or down
Cooling	Forced Air

Maximum Dimensions:		
Length	9.06 in; 230.17	mm
Diameter	7.05 in; 179.07	mm
Net Weight (Approximate)	12 lbs; 5.5	kg
Shipping Weight (Approximate)	23 lbs; 10.5	kg

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 7.5 volts	73	78	A
Interelectrode Capacitance (grounded cathode connection) [1]			
Cin	108	122	pF
Cout	18	23	pF
Cgp	---	1.0	pF
Interelectrode Capacitance (grounded grid connection) [1]			
Cin	48	58	pF
Cout	18	23	pF
Cpk	---	0.16	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 110 megahertz)

Class-C Telegraphy or FM Telephony (Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE up to 30 MHz	7500	VOLTS
30 to 60 MHz	7000	VOLTS
60 to 110 MHz	6500	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT up to 30 MHz	3.0	AMPERES
30 to 60 MHz	2.8	AMPERES
60 to 110 MHz	2.6	AMPERES
PLATE DISSIPATION	10,000	WATTS
SCREEN DISSIPATION	250	WATTS
GRID DISSIPATION	75	WATTS

TYPICAL OPERATION
(Frequencies below 30 megahertz)

DC Plate Voltage	7500	Vdc
DC Screen Voltage	500	Vdc
DC Grid Voltage	-350	Vdc
DC Plate Current	2.8	Adc
DC Screen Current	0.5	Adc
DC Grid Current	0.25	Adc
Peak rf Grid Voltage	590	v
Driving Power	150	W
Plate Dissipation	5000	W
Plate Output Power	16,000	W

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER Class C Telephony (Carrier conditions except where noted)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	5000	VOLTS
DC SCREEN VOLTAGE	1000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION [1]	6650	WATTS
SCREEN DISSIPATION	250	WATTS
GRID DISSIPATION	75	WATTS

1. Corresponds to 10,000 watts at 100% sine-wave modulation.

TYPICAL OPERATION
(Frequencies below 30 megahertz)

DC Plate Voltage	5000	Vdc
DC Screen Voltage	500	Vdc
Peak af Screen Voltage (For 100% modulation)	450	v
DC Grid Voltage	-400	Vdc
DC Plate Current	1.4	Adc
DC Screen Current	0.26	Adc
DC Grid Current	0.05	Adc
Peak rf Grid Voltage	520	v
Grid Driving Power	25	W
Plate Dissipation	1100	W
Plate Output Power	5.8	kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class AB 1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPERES
PLATE DISSIPATION	12,000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION, two tubes

DC Plate Voltage	4000	5000	6000	7500 Vdc
DC Screen Voltage	1500	1500	1500	1500 Vdc
DC Grid Voltage	-315	-320	-330	-340 Vdc
Max.Signal Plate Current	6.66	6.66	6.66	6.66 Adc
Zero-Signal Plate Current[1]	0.50	0.50	0.50	0.50 Adc
Max.Signal Screen Current	0.33	0.32	0.30	0.25 Adc
Zero-Signal Screen Current	0	0	0	0 Adc
Peak af Driving Voltage	305	310	320	330 v
Driving Power	0	0	0	0 W
Load Resistance plate to plate	940	1320	1700	2280 Ω
Max. Signal Plate Dissipation	6670	7950	8100	9050 W
Max.Signal Plate Output Power	13,300	17,500	23,800	31,900 W

1. Per Tube

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB 1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPERES
PLATE DISSIPATION	12,000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions(Frequencies below 30 megahertz)

DC Plate Voltage	7500 Vdc
DC Screen Voltage	1500 Vdc
DC Grid Voltage[1]	-340 Vdc
Max.Signal Plate Current	3.33 Adc
Zero-Signal Plate Current	0.50 Adc
Max.Signal Screen Current	.125 Adc
Peak rf Grid Voltage	330 v
Driving Power	0 W
Plate Dissipation	9050 W
Plate Output Power[2]	15,950 W

1. Adjust grid voltage to obtain specified Zero-Signal plate current.
2. PEP output or rf output power at crest of modulation envelope.

NOTE: TYPICAL OPERATION data is obtained by direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias screen and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In Class C service, if grid bias is obtained principally by means of a grid resistor the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

APPLICATION

MECHANICAL

MOUNTING - The 4CX10000D must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC Air-System Socket Type SK-300A has been designed especially for the concentric base terminals of the 4CX10000D. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-1306, into the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces of the 4CX10000D is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megahertz) for the socket/tube/chimney combination.

	SEA LEVEL		10,000 FEET	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop(Inches of water)	Air Flow (CFM)	Pressure Drop(Inches of water)
4000	114	0.36	166	0.53
6000	226	1.0	330	1.46
8000	363	2.0	530	2.90
10000	500	3.5	730	5.10
12000	720	6.0	1050	8.8

* Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 4CX10000D is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus 5 percent from the rated value.

ELECTRODE DISSIPATION RATINGS - The maximum dissipation ratings for the 4CX10000D must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

CONTROL-GRID OPERATION - The 4CX10000D control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

SCREEN-GRID OPERATION - The power dissipated by the screen of the 4CX10000D must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX10000D is 10,000 watts for most applications, but for audio and SSB amplifier applications, the maximum allowable dissipation is 12,000 watts.

When the 4CX10000D is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 6650-watt maximum plate dissipation rating will be exceeded.

HIGH VOLTAGE - Normal operating voltages used with the 4CX10000D are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

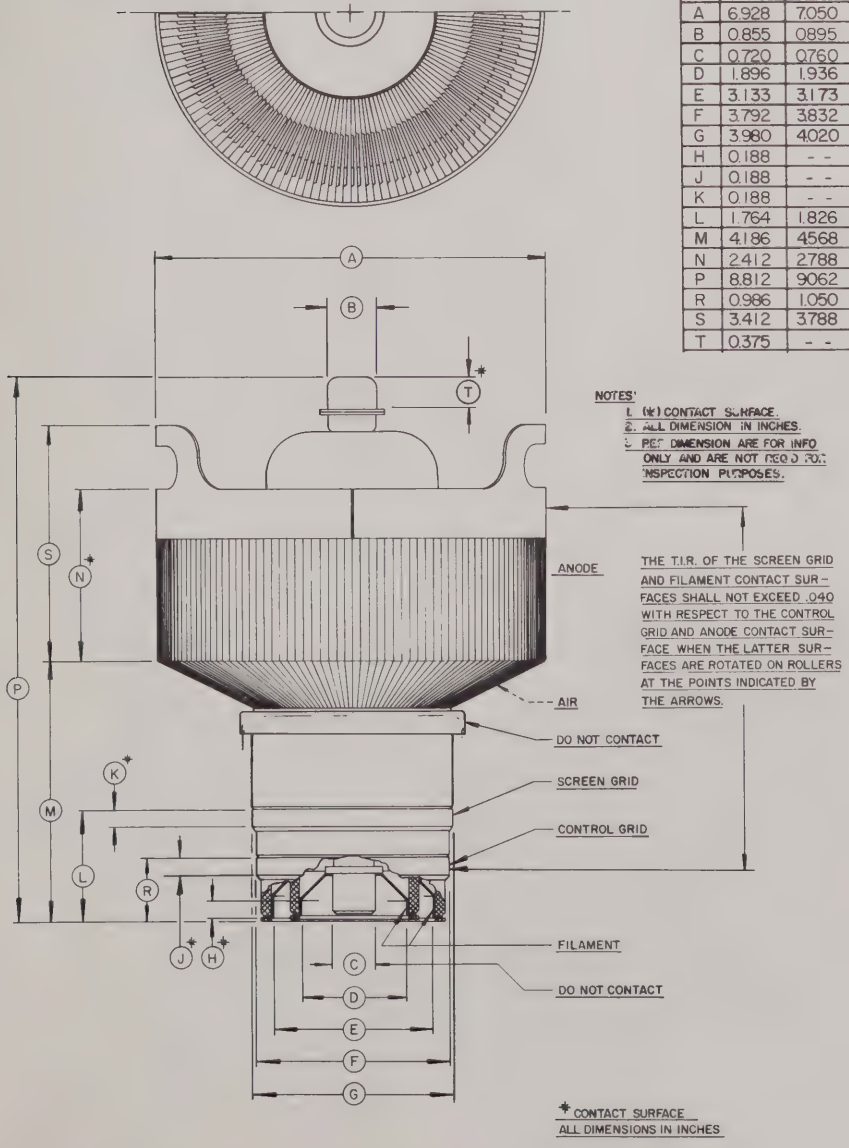
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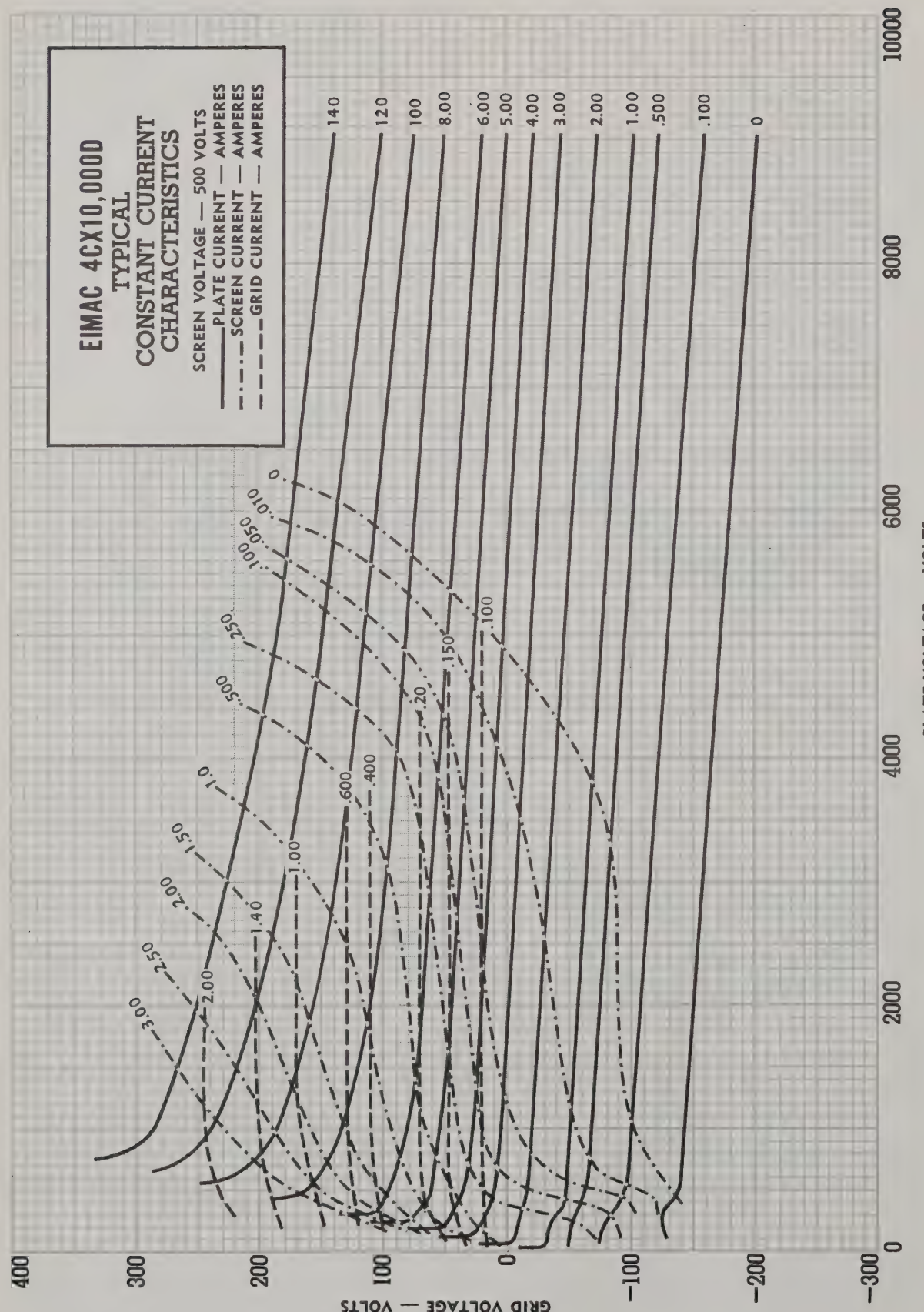
applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

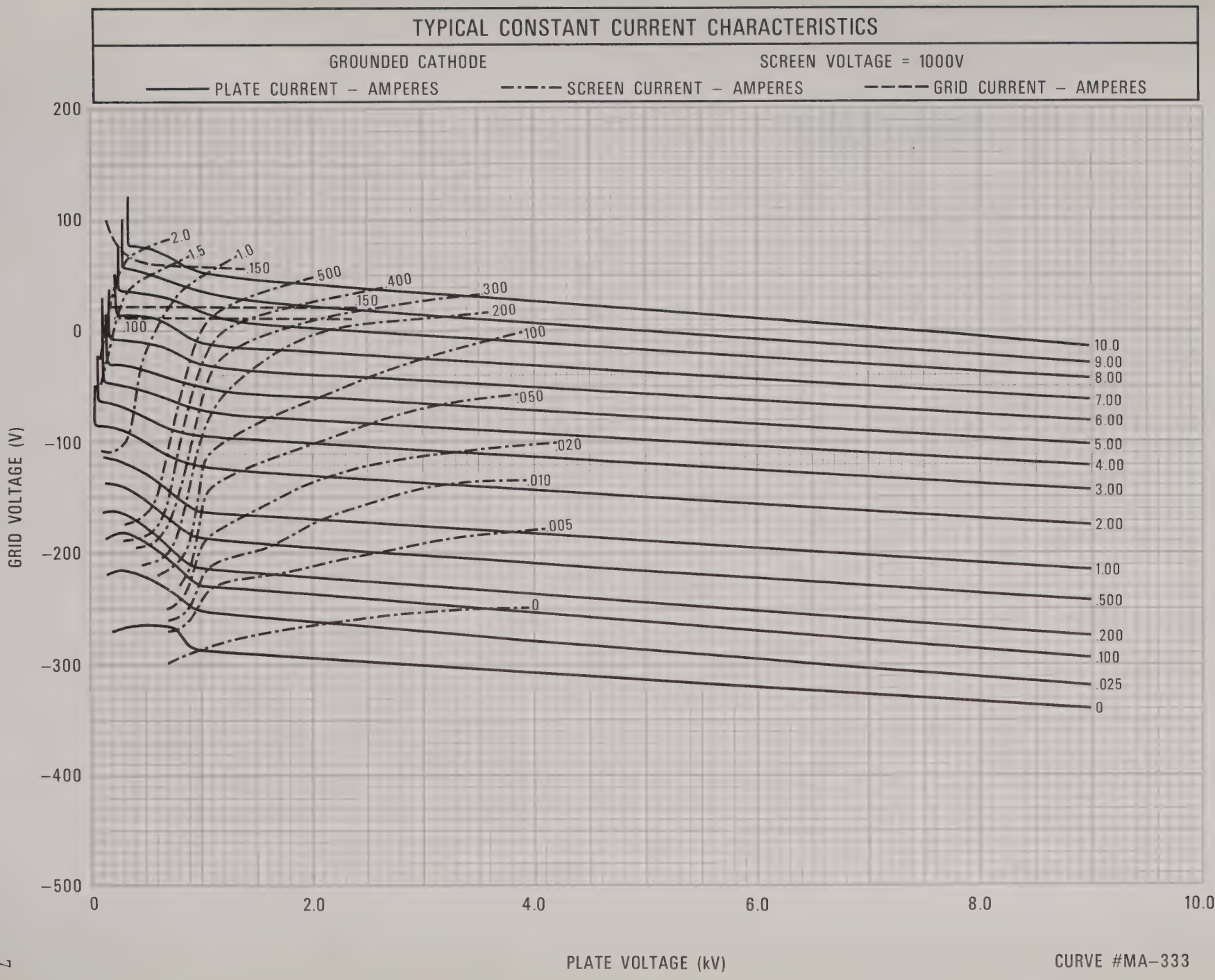
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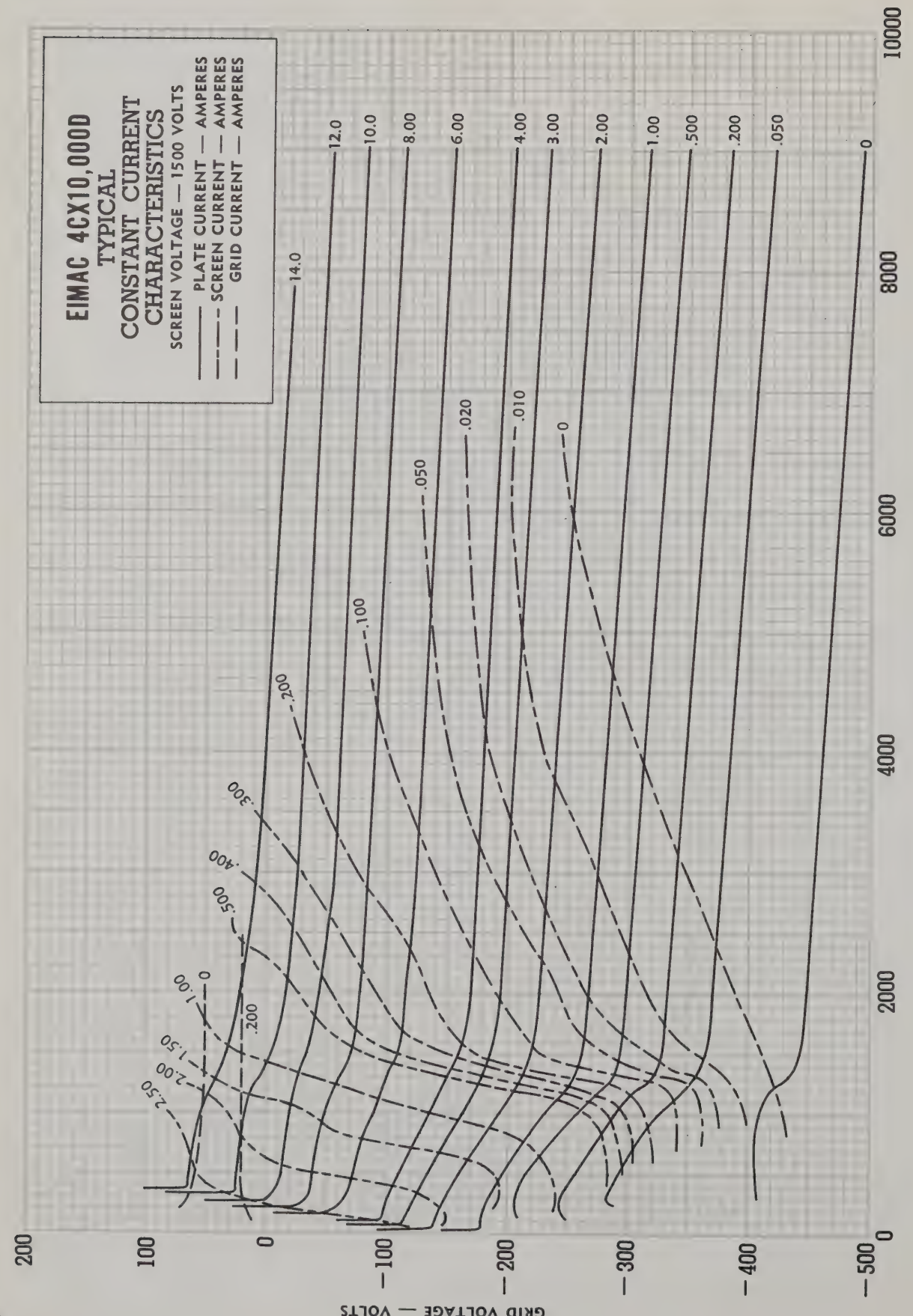
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	6.928	7.050	- -	175.97	179.07	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
G	3.980	4.020	- -	101.09	102.11	- -
H	0.188	- -	- -	4.77	- -	- -
J	0.188	- -	- -	4.77	- -	- -
K	0.188	- -	- -	4.77	- -	- -
L	1.764	1.826	- -	44.80	46.38	- -
M	4.186	4.568	- -	106.32	116.03	- -
N	2.412	2.788	- -	61.26	70.81	- -
P	8.812	9.062	- -	223.82	230.17	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.412	3.788	- -	86.66	96.21	- -
T	0.375	- -	- -	9.52	- -	- -




EIMAC 4CX10,000D
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
140
120
100
8.00
6.00
5.00
4.00
3.00
2.00
1.00
.500
.100
0
.010
.050
.100
.250
.500
1.0
1.50
2.00
2.50
3.00
1.40
.600
.400
.20
.150
.100
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

CURVE MA-335


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 1000V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
200
100
0
−100
−200
−300
−400
−500
GRID VOLTAGE (V)
0
2.0
4.0
6.0
8.0
10.0
PLATE VOLTAGE (kV)
2.0
1.5
1.0
.150
.500
.400
.300
150
.200
.100
.100
.050
.020
.010
.005
0
10.0
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
.500
.200
.100
.025
0
CURVE #MA–333


EIMAC 4CX10,000D
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 1500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
14.0
12.0
10.0
8.00
6.00
4.00
3.00
2.00
1.00
.500
.200
.050
.020
.010
0
.100
.200
300
400
500
2.50
2.00
1.50
1.00
0
.200
200
100
0
−100
−200
−300
−400
−500
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

CURVE MA-317

4CX10,000J

TECHNICAL DATA

RADIAL-BEAM
POWER TETRODE

The EIMAC 4CX10,000J is a compact, high-power, ceramic/metal, forced-air cooled tetrode with a rated maximum plate dissipation of 12,000 watts. It incorporates rugged internal construction features, including a mesh filament/cathode.

The 4CX10,000J is specifically designed for exceptionally low intermodulation distortion in radio-frequency linear amplifier service.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	7.5 ± 0.37	V
Current, at 7.5 volts	103	A
Amplification Factor (Average):		
Grid to Screen	4.5	
Direct Interelectrode Capacitance (grounded filament)[2]		
Cin	120	pF
Cout	20.5	pF
Cgp	0.7	pF
Direct Interelectrode Capacitance (grounded grid) [2]		
Cin	56	pF
Cout	21.5	pF
Cpk	0.10	pF
Frequency of Maximum Rating:		
CW	100	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:		
Length	9.125 in; 231.77	mm
Diameter	7.050 in; 179.07	mm
Net Weight	12.2 lb; 5.55	kg
Operating Position	Axis vertical, base up or down	

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Maximum Operating Temperature:	
Ceramic/Metal Seals or Anode Core	250°C
Cooling	Forced Air
Base	Special concentric
Recommended Air System Socket	SK-300A
Recommended (Air) Chimney	SK-1306

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN
Class AB1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7500	VOLTS
DC SCREEN VOLTAGE	1600	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	12,000	WATTS
SCREEN DISSIPATION	250	WATTS
GRID DISSIPATION	75	WATTS

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.
3. Useful power is that delivered to the load.
4. Referenced against one tone of a two equal-tone signal.

TYPICAL OPERATION
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	7500	Vdc
Screen Voltage	1600	Vdc
Grid Voltage [1]	-400	Vdc
Zero-Signal Plate Current	300	mAdc
Single-Tone Plate Current	2.2	Adc
Single-Tone Screen Current [2]	30	mAdc
Peak rf Grid Voltage [2]	400	v
Single-Tone Plate Dissipation	8500	W
Useful Power Output (PEP) [3]	10	kW
Load Impedance	1650	Ω
Intermodulation Distortion Products [4]:		
3rd Order	-35	dB
5th Order	-40	dB

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in screen current. The screen current which results when the desired plate current is obtained is incidental and varies from tube to tube. This current variation causes no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 7.5 volts	98	108	A
Interelectrode Capacitances[1](grounded filament connection)			
Cin	113	127	pF
Cout	18	23	pF
Cgp	---	1.0	pF
Interelectrode Capacitances[1](grounded grid connection)			
Cin	51	61	pF
Cout	19	24	pF
Cpk	---	0.16	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CX10,000J must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX10,000J. The use of recommended air-flow rates through this socket pro-

vides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-1316, into the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces of the 4CX10,000J is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megahertz). The pressure drop values shown are for the Tube/Socket/Chimney combination.

	SEA LEVEL		10,000 FEET	
Plate * Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (In. of water)	Air Flow (CFM)	Pressure Drop (In. of water)
4000	110	0.4	160	0.6
6000	200	0.8	290	1.2
8000	315	1.7	460	2.5
10000	445	2.8	645	4.1
12000	600	4.4	870	6.4

* Since the power dissipated by the filament represents about 770 watts and since grid-plus screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1200 watts dissipation.

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

IMPACT AND VIBRATION - The 4CX10,000J is designed to operate under shock and vibration conditions which might disable a less rugged tube. Production tubes are subjected to testing to insure ability to withstand 15 G impact at 11 milliseconds duration and 2 G vibratory acceleration over the range of 5 to 55 Hz.

ELECTRICAL

FILAMENT VOLTAGE - The rated filament voltage for the 4CX10,000J is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

GRID DISSIPATION - The 4CX10,000J control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. Grid dissipation is approximately the product of dc grid current and peak positive grid voltage. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

SCREEN DISSIPATION - The power dissipated by the screen of the 4CX10,000J must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX10,000J is 12,000 watts. Plate dissipation may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

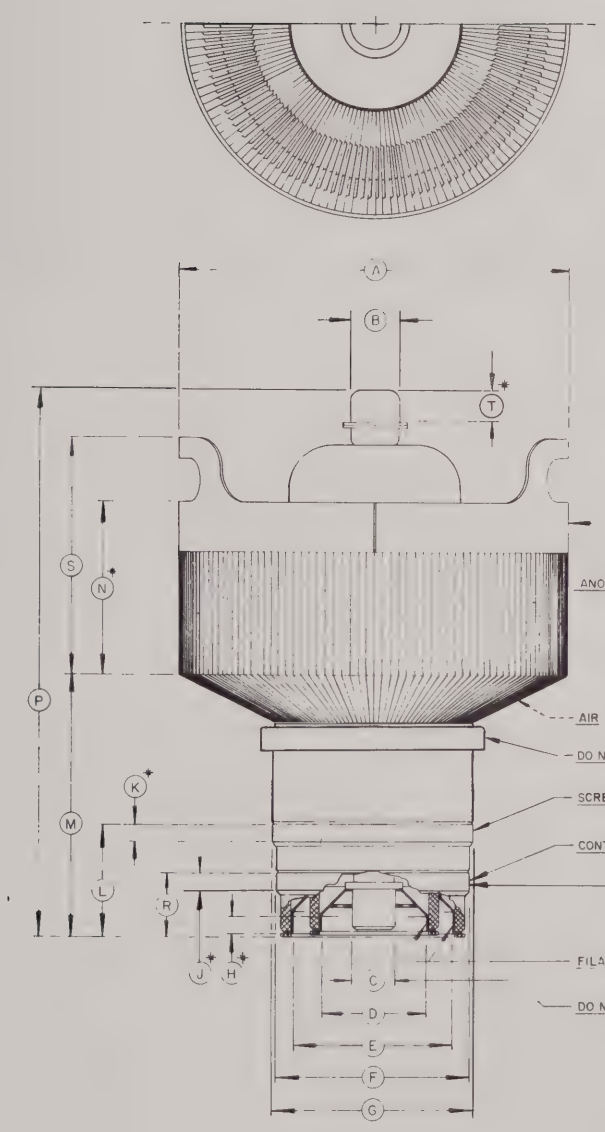
HIGH VOLTAGE - The 4CX10,000J operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard

RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

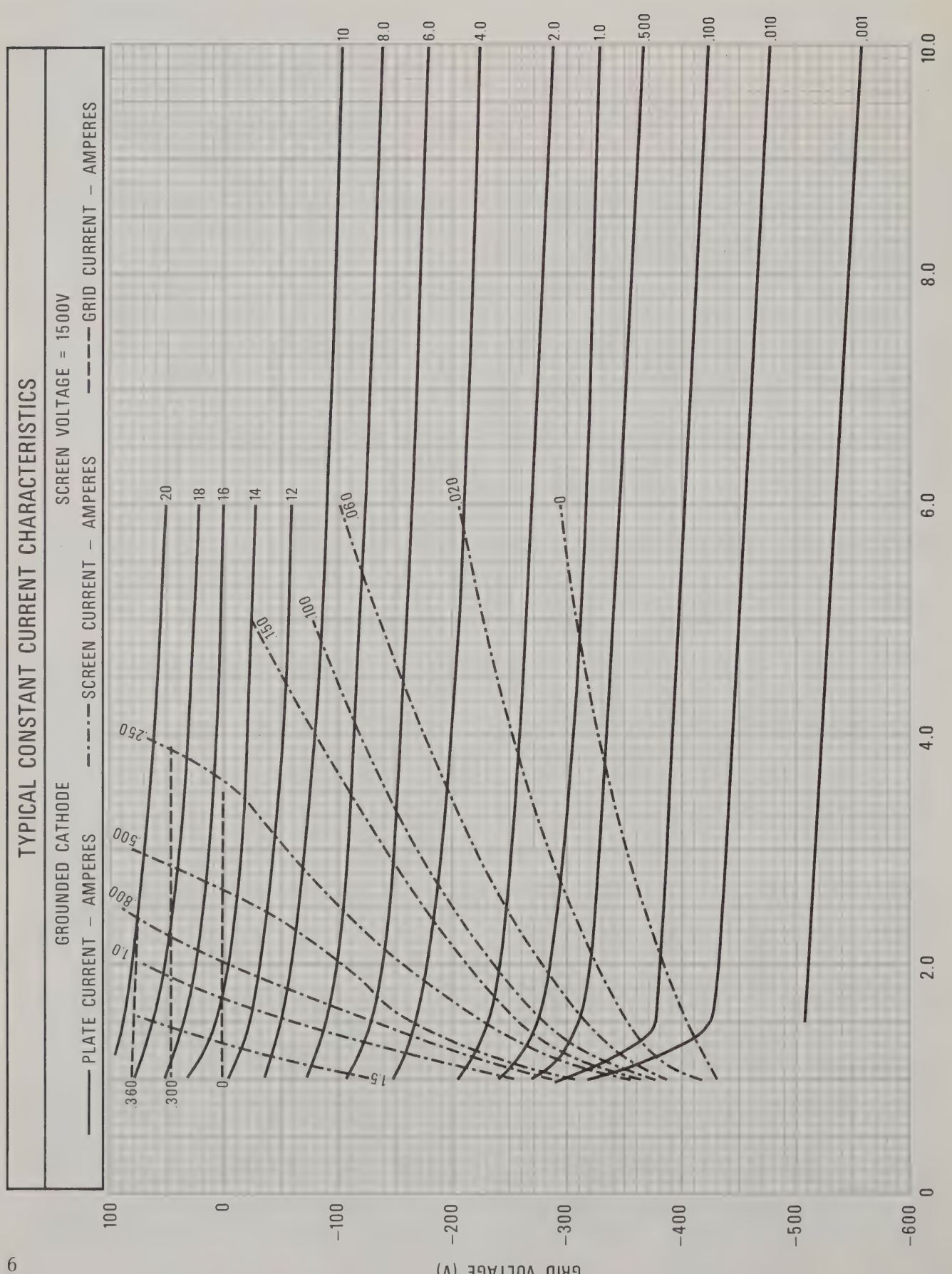
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF	MIN.	MAX.	REF
A	6.928	7.050	- -	175.97	179.07	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
G	3.980	4.020	- -	101.09	102.11	- -
H	0.188	- -	- -	4.77	- -	- -
J	0.188	- -	- -	4.77	- -	- -
K	0.188	- -	- -	4.77	- -	- -
L	1.764	1.826	- -	44.80	46.38	- -
M	4.186	4.568	- -	106.32	116.03	- -
N	2.412	2.788	- -	61.26	70.81	- -
P	8.812	9.062	- -	223.82	230.17	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.412	3.788	- -	86.66	96.21	- -
T	0.375	- -	- -	9.52	- -	- -

NOTES:
1. (K) CONTACT SURFACE.
2. ALL DIMENSIONS IN INCHES
3. REF DIMENSION ARE FOR INFO ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.

THE T.I.R. OF THE SCREEN GRID AND FILAMENT CONTACT SURFACES SHALL NOT EXCEED .040 WITH RESPECT TO THE CONTROL GRID AND ANODE CONTACT SURFACE WHEN THE LATTER SURFACES ARE ROTATED ON ROLLERS AT THE POINTS INDICATED BY THE ARROWS.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 1500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #4339

8281
4CX15,000A

RADIAL BEAM
POWER TETRODE

The EIMAC 8281/4CX15,000A is a ceramic/metal power tetrode intended for use in audio or radio frequency applications. It features a new type of internal mechanical structure which results in higher rf operating efficiency. Low rf losses in this mechanical structure permit operation of the 8281/4CX15,000A at full ratings up to 110 MHz, and at reduced ratings, to 225 MHz.

The 8281/4CX15,000A is also recommended for radio-frequency linear power amplifier service, and for television linear amplifier service.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	160 A
Amplification Factor, average	
Grid to Screen	4.5
Direct Interelectrode Capacitances (cathode grounded):[2]	
Cin	160.0 pF
Cout	24.5 pF
Cgp	1.5 pF
Direct Interelectrode Capacitances (grid and screen grounded):[2]	
Cin	67.0 pF
Cout	25.5 pF
Cpk	0.2 pF
Maximum Frequency Ratings	
CW	110 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	9.375 in; 238.13 mm
Diameter	7.580 in; 192.53 mm
Net Weight	12.8 lb; 5.81 kg
Operating Position	Axis vertical, base up or down
Cooling	Forced air
Operating Temperature, maximum	
Ceramic/Metal Seals and Anode Core	250°C
Base	Special, concentric
Recommended Air System Socket	SK-300A
Recommended Air Chimney	SK-316

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RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN, Class AB_1

ABSOLUTE MAXIMUM RATINGS

PLATE VOLTAGE	10.0	kVdc
SCREEN VOLTAGE	2.0	kVdc
PLATE CURRENT	6.0	Adc
PLATE DISSIPATION	15.0	kW
SCREEN DISSIPATION	450	W
GRID DISSIPATION	200	W

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION (Frequencies to 110 MHz)
Peak Envelope or Modulation Crest Conditions

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	1,500	1,500	Vdc
Grid Voltage [1]	-350	-370	Vdc
Zero-Signal Plate Current	1.0	1.0	Adc
Single-Tone Plate Current	4.0	4.25	Adc
Single-Tone Screen Current [2]	170	150	mAdc
Peak rf Grid Voltage [2]	330	340	v
Plate Dissipation	12.2	14.0	kW
Single-Tone Plate Output Power	20.8	28.5	kW
Resonant Load Impedance	865	1,260	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

PLATE VOLTAGE	10.0	kVdc
SCREEN VOLTAGE	2.0	kVdc
PLATE CURRENT	5.0	Adc
PLATE DISSIPATION	15.0	kW
SCREEN DISSIPATION	450	W
GRID DISSIPATION	200	W

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	750	750	Vdc
Grid Voltage	-510	-550	Vdc
Plate Current	4.65	4.55	Adc
Screen Current [1]	0.59	0.54	Adc
Grid Current [1]	0.30	0.27	Adc
Peak rf Grid Voltage [1]	730	790	v
Calculated Driving Power	220	220	W
Plate Dissipation	8.1	9.0	kW
Plate Output Power	26.7	36.5	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER
GRID DRIVEN, Class C Telephony
(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

PLATE VOLTAGE	8.0	kVdc
SCREEN VOLTAGE	1.5	kVdc
PLATE CURRENT	4.0	Adc
PLATE DISSIPATION	10.0	kW
SCREEN DISSIPATION	450	W
GRID DISSIPATION	200	W

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	6,000	8,000	Vdc
Screen Voltage	750	750	Vdc
Grid Voltage	-600	-640	Vdc
Plate Current	3.75	3.65	Adc
Screen Current [1]	0.45	0.43	Adc
Grid Current [1]	0.18	0.18	Adc
Peak af Screen Voltage [1] 100% modulation	740	710	v
Peak rf Grid Voltage [1]	800	840	v
Calculated Driving Power	150	150	W
Plate Dissipation	5.1	5.8	kW
Plate Output Power	17.4	23.5	kW

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
GRID DRIVEN, Class AB_1 (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

PLATE VOLTAGE	10.0	kVdc
SCREEN VOLTAGE	2.0	kVdc
PLATE CURRENT	6.0	Adc
PLATE DISSIPATION	15.0	kW
SCREEN DISSIPATION	450	W
GRID DISSIPATION	200	W

TYPICAL OPERATION (Two tubes)

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	1,500	1,500	Vdc
Grid Voltage [1]	-350	-370	Vdc
Zero-Signal Plate Current	1.00	1.00	Adc
Maximum Signal Plate Current	8.80	8.50	Adc
Maximum Signal Screen Current [2]	0.34	0.30	Adc
Peak af Grid Voltage [2]	330	340	v
Maximum Signal Plate Dissipation	12.2	14.0	kW
Plate Output Power	41.6	57.0	kW
Load Resistance (plate to plate)	1.730	2.520	Ω

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION values are obtained by calculations from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater Current, at 6.3 volts	152	168	A
Interelectrode Capacitances, cathode grounded [1]			
Cin	154.0	167.0	pF
Cout	22.0	27.0	pF
Cgp	----	2.0	pF
Interelectrode Capacitances, grid and screen grounded [1]			
Cin	62.0	72.0	pF
Cout	23.0	28.0	pF
Cpk	----	0.3	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CX15,000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC Air-System Socket Type SK-300A is designed especially for the concentric base terminals of the 4CX15,000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through the SK-316 Air Chimney, into the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces of the 4CX15,000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 225°C in 50°C ambient air are tabulated below (for operation below 30 megahertz). This data is for the tube mounted in an SK-300A socket with an SK-316 chimney.

SEA LEVEL			10,000 FEET	
Plate Dissipation * (Watts)	Air Flow (CFM)	Pressure Drop(Inches of Water)	Air Flow (CFM)	Pressure Drop(Inches of Water)
7,500	230	.7	336	1.0
12,500	490	2.7	710	4.1
15,000	645	4.6	945	7.0

*Since the power dissipated by the filament represents about 1000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 600 watts, allowance has been made in preparing this tabulation for an additional 1600 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 4CX15,000A is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

ELECTRODE DISSIPATION RATINGS - The maximum dissipation ratings for the 4CX15,000A must be respected to avoid damage to the tube. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

GRID OPERATION - The 4CX15,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

SCREEN OPERATION - The power dissipated by the screen of the 4CX15,000A must not exceed 450 watts.

Screen dissipation, in cases where there is no AC applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 450 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX15,000A is 15,000 watts.

When the 4CX15,000A is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 10,000 watt maximum plate dissipation rating will be exceeded.

HIGH VOLTAGE - Normal operating voltages used with the 4CX15,000A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CX15,000A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 4CX 15,000A, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry --- the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

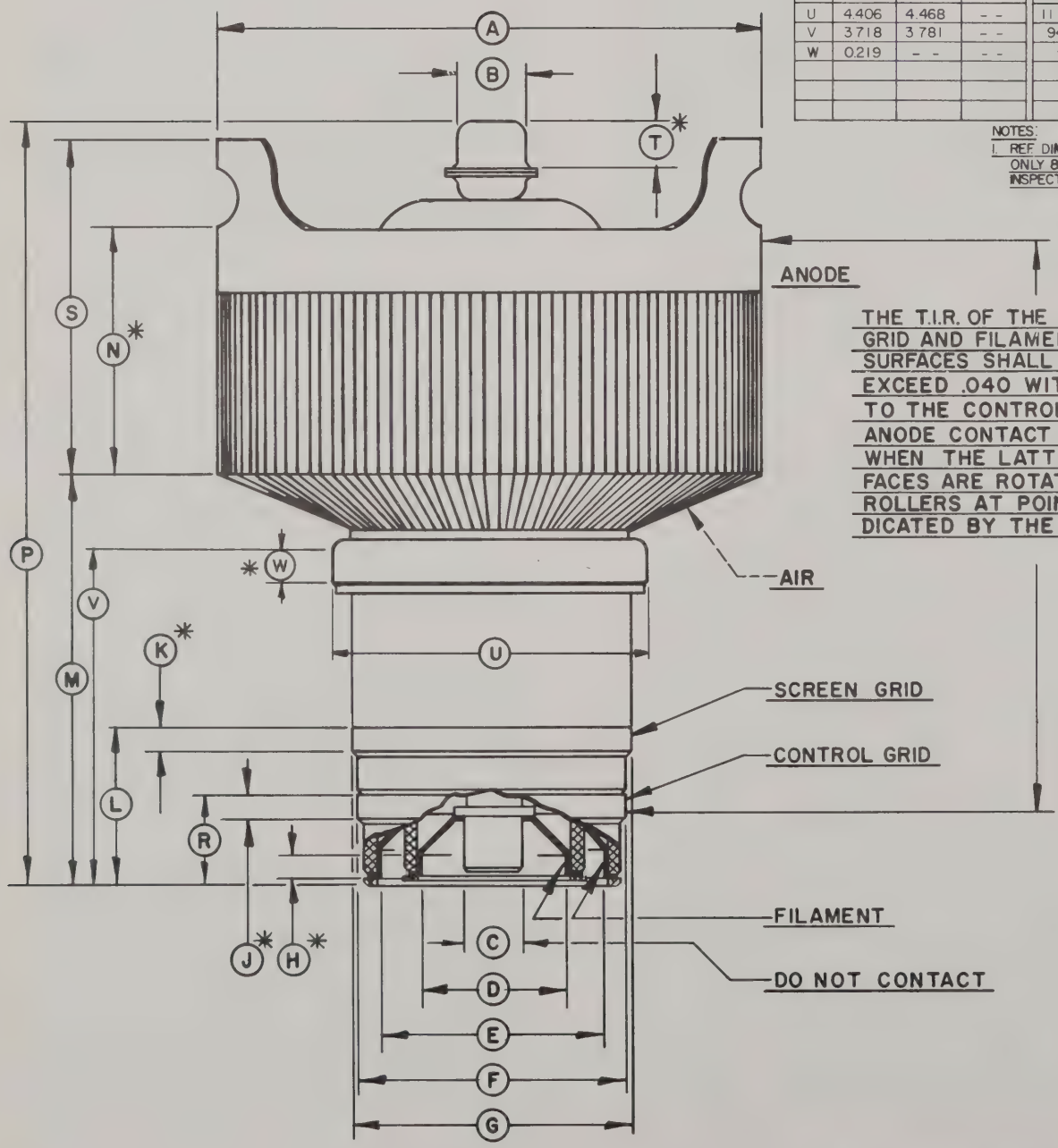
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Dept., Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, Califomia, 94070 for information and recommendations.

DIMENSIONAL DATA

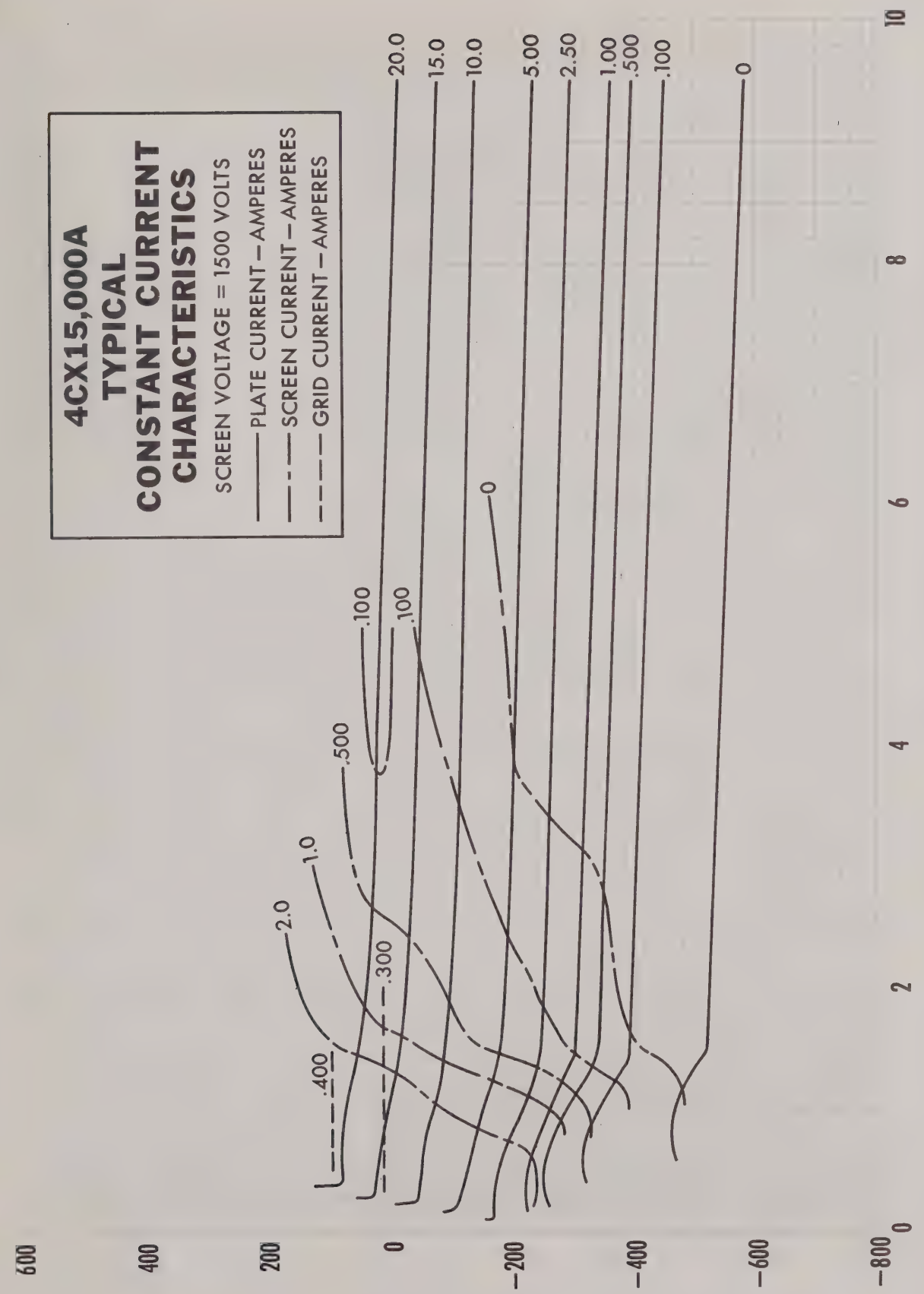
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF	MIN.	MAX.	REF
A	7.460	7.580	- -	189.48	192.53	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	46.63	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
G	3.980	4.020	- -	101.09	102.11	- -
H	0.188	- -	- -	4.78	- -	- -
J	0.188	- -	- -	4.78	- -	- -
K	0.188	- -	- -	4.78	- -	- -
L	1.764	1.826	- -	44.81	46.38	- -
M	4.659	4.783	- -	118.34	121.49	- -
N	2.412	2.788	- -	61.26	70.82	- -
P	9.000	9.375	- -	228.60	238.13	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.560	3.684	- -	90.42	93.57	- -
T	0.375	- -	- -	9.53	- -	- -
U	4.406	4.468	- -	111.91	113.49	- -
V	3.718	3.781	- -	94.44	96.04	- -
W	0.219	- -	- -	5.56	- -	- -

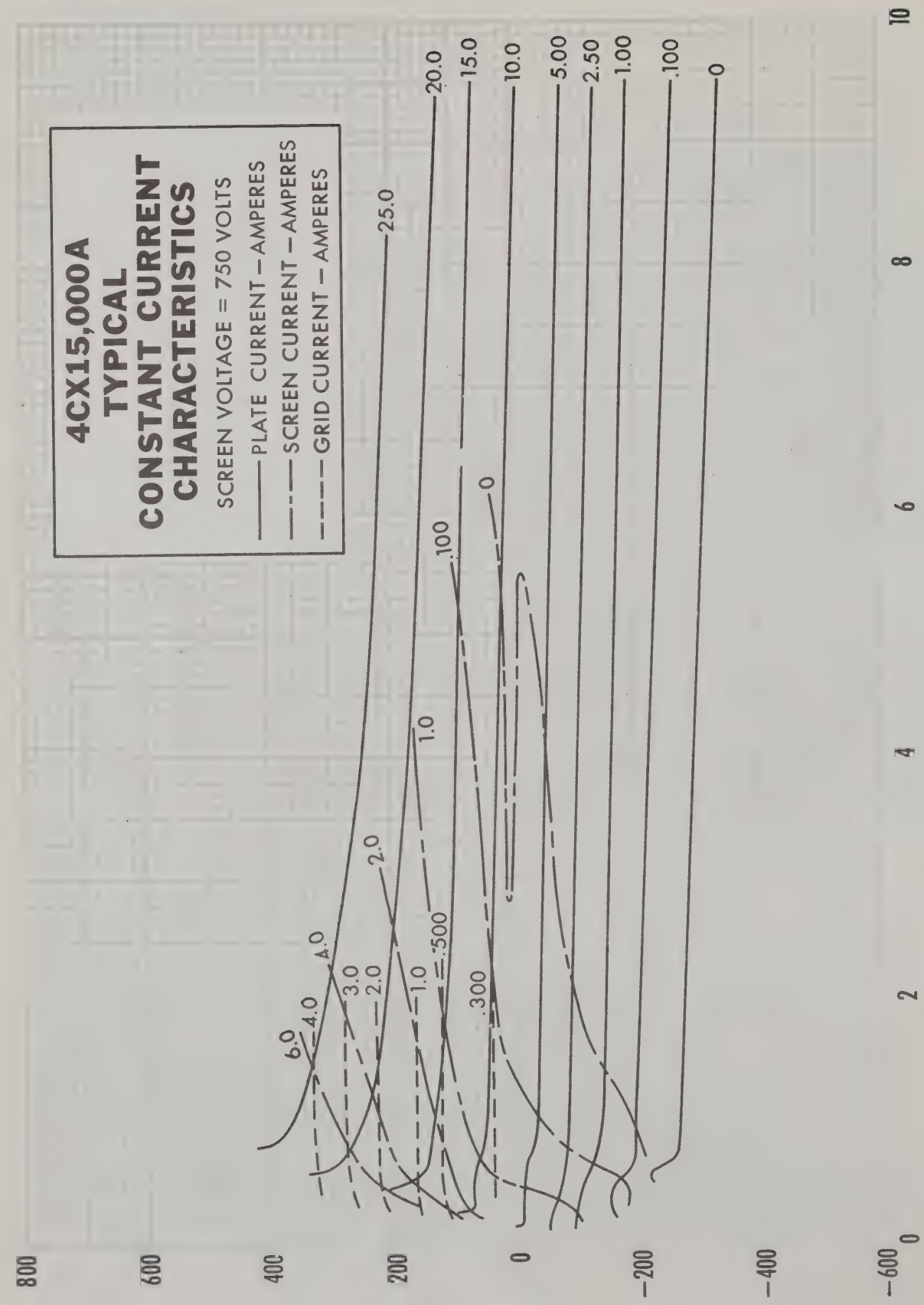
NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



THE T.I.R. OF THE SCREEN GRID AND FILAMENT CONTACT SURFACES SHALL NOT EXCEED .040 WITH RESPECT TO THE CONTROL GRID AND ANODE CONTACT SURFACE WHEN THE LATTER SURFACES ARE ROTATED ON ROLLERS AT POINTS INDICATED BY THE ARROWS

* CONTACT SURFACE


4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
20.0
15.0
10.0
5.00
2.50
1.00
.500
.100
0
.100
.100
.500
1.0
2.0
.300
.400
600
400
200
0
−200
−400
−600
−800
0
2
4
6
8
10
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)


4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0
6.0
4.0
3.0
2.0
1.0
.500
.300
.100
0
GRID VOLTAGE (V)
800
600
400
200
0
-200
-400
-600
0
2
4
6
8
10
PLATE VOLTAGE (kV)

TECHNICAL DATA

8910
4CX15,000J

RADIAL BEAM
POWER TETRODE

The EIMAC 8910/4CX15,000J is a ceramic/metal, forced-air cooled power tetrode intended for use in audio or radio frequency applications. The internal structure features a mesh filament and a mechanical design which assures good strength and high rf operating efficiency.

Full ratings on the 8910/4CX15,000J apply to 110 MHz, and it is especially recommended for radio frequency linear amplifier service.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament; Thoriated Tungsten Mesh	
Voltage	7.5 ± 0.3 V
Current, at 7.5 volts	160 A
Amplification Factor, average	
Grid to Screen	4.5
Direct Interelectrode Capacitances (cathode grounded);[2]	
Cin	160.0 pF
Cout	26.5 pF
Cgp	1.5 pF
Direct Interelectrode Capacitances (grid and screen grounded):[2]	
Cin	67.0 pF
Cout	27.5 pF
Cpk	0.2 pF
Maximum Frequency Ratings	
CW	110 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	9.375 in; 238.13 mm
Diameter	7.580 in; 192.53 mm
Net Weight	12.8 lb; 5.81 kg
Operating Position	Axis vertical, base up or down
Cooling	Forced air
Operating Temperature, maximum	
Ceramic/Metal Seals and Anode Core	250° C

(Effective 10-15-71) © 1971 by Varian

Printed in U.S.A.

Base	Special, concentric
Recommended Air System Socket	SK-300A
Recommended Air Chimney	SK-316

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN, Class AB

ABSOLUTE MAXIMUM RATINGS

PLATE VOLTAGE	10.0 kVdc
SCREEN VOLTAGE	2.0 kVdc
PLATE CURRENT	6.0 Adc
PLATE DISSIPATION	15.0 kW
SCREEN DISSIPATION	450 W
GRID DISSIPATION	200 W

1. Adjust for specified zero-signal plate current.
2. Approximate value.
3. Useful power is that delivered to the load.
4. Referenced against one tone of a two equal-tone signal.

TYPICAL OPERATION
Peak Envelope or Modulation Crest Conditions
Class AB_1

Plate Voltage	7500 Vdc
Screen Voltage	1250 Vdc
Grid Voltage [1]	-250 Vdc
Zero-Signal Plate Current	1.25 Adc
Single-Tone Plate Current	2.90 Adc
Single-Tone Screen Current[2]	200 mAdc
Peak rf Grid Voltage[2]	200 v
Plate Dissipation	8300 W
Single-Tone Useful Power Out[3]	12 kW
Resonant Load Impedance	1450 Ω
Intermod. Distortion Products [4]	
3rd Order	-41 dB
5th Order	-41 dB

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

PLATE VOLTAGE	10.0 kVdc
SCREEN VOLTAGE	2.0 kVdc
PLATE CURRENT	5.0 Adc
PLATE DISSIPATION	15.0 kW
SCREEN DISSIPATION	450 W
GRID DISSIPATION	200 W

TYPICAL OPERATION

Plate Voltage	7,500	10,000 Vdc
Screen Voltage	750	750 Vdc
Grid Voltage	-510	-550 Vdc
Plate Current	4.65	4.55 Adc
Screen Current [1]	0.59	0.54 Adc
Grid Current [1]	0.30	0.27 Adc
Peak rf Grid Voltage [1]	730	790 v
Calculated Driving Power	220	220 W
Plate Dissipation	8.1	9.0 kW
Plate Output Power	26.7	36.5 kW

1. Approximate value

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER
GRID DRIVEN, Class C Telephony
(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

PLATE VOLTAGE	8.0 kVdc
SCREEN VOLTAGE	1.5 kVdc
PLATE CURRENT	4.0 Adc
PLATE DISSIPATION	10.0 kW
SCREEN DISSIPATION	450 W
GRID DISSIPATION	200 W

TYPICAL OPERATION

Plate Voltage	6,000	8,000 Vdc
Screen Voltage	750	750 Vdc
Grid Voltage	-600	-640 Vdc
Plate Current	3.75	3.65 Adc
Screen Current [1]	0.45	0.43 Adc
Grid Current [1]	0.18	0.18 Adc
Peak af Screen Voltage [1]		
100% modulation	740	710 v
Peak rf Grid Voltage [1]	800	840 v
Calculated Driving Power	150	150 W
Plate Dissipation	5.1	5.8 kW
Plate Output Power	17.4	23.5 kW

1. Approximate value

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
GRID DRIVEN, Class AB_1 (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

PLATE VOLTAGE	10.0 kVdc
SCREEN VOLTAGE	2.0 kVdc
PLATE CURRENT	6.0 Adc
PLATE DISSIPATION	15.0 kW
SCREEN DISSIPATION	450 W
GRID DISSIPATION	200 W

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	7,500	10,000 Vdc
Screen Voltage	1,500	1,500 Vdc
Grid Voltage [1]	-350	-370 Vdc
Zero-Signal Plate Current	1.00	1.00 Adc
Maximum Signal Plate Current	8.80	8.50 Adc
Maximum Signal Screen Current [2]	0.34	0.30 Adc
Peak af Grid Voltage [2]	330	340 v
Maximum Signal Plate Dissipation	12.2	14.0 kW
Plate Output Power	41.6	57.0 kW
Load Resistance (plate to plate)	1.730	2.520 Ω

TYPICAL OPERATION values are obtained by calculations from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater Current, at 7.5 volts	148	168	A
Interelectrode Capacitances, cathode grounded [1]			
Cin	154.0	167.0	pF
Cout	24.0	29.0	pF
Cgp	----	2.0	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CX15,000J must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC Air-System Socket Type SK-300A is designed especially for the concentric base terminals of the 4CX15,000J. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through the SK-316 Air Chimney, into the anode cooling fins.

COOLING - The maximum temperature rating for the external surfaces of the 4CX15,000J is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 225°C in 50°C ambient air are tabulated below (for operation below 30 megahertz). This data is for the tube mounted in an SK-300A socket with an SK-316 chimney.

SEA LEVEL			10,000 FEET	
Plate Dissipation * (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
7,500	230	.7	336	1.0
12,500	490	2.7	710	4.1
15,000	645	4.6	945	7.0

* Since the power dissipated by the filament represents about 1000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 600 watts, allowance has been made in preparing this tabulation for an additional 1600 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

IMPACT AND VIBRATION - The 4CX15,000J is designed to operate under shock and vibration conditions which might disable a less rugged tube. Production tubes are subjected to testing to insure ability to withstand 15 G impact at 11 milliseconds duration and 2 G vibratory acceleration over the range of 5 to 55 Hz.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 4CX15,000J is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

ELECTRODE DISSIPATION RATINGS - The maximum dissipation ratings for the 4CX15,000J must be respected to avoid damage to the tube. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

GRID OPERATION - The 4CX15,000J control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

SCREEN OPERATION - The power dissipated by the screen of the 4CX15,000J must not exceed 450 watts.

Screen dissipation, in cases where there is no AC applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 450 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX15,000J is 15,000 watts.

When the 4CX15,000J is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 10,000 watt maximum plate dissipation rating will be exceeded.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. This tube, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing win-

dows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as this, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry--the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

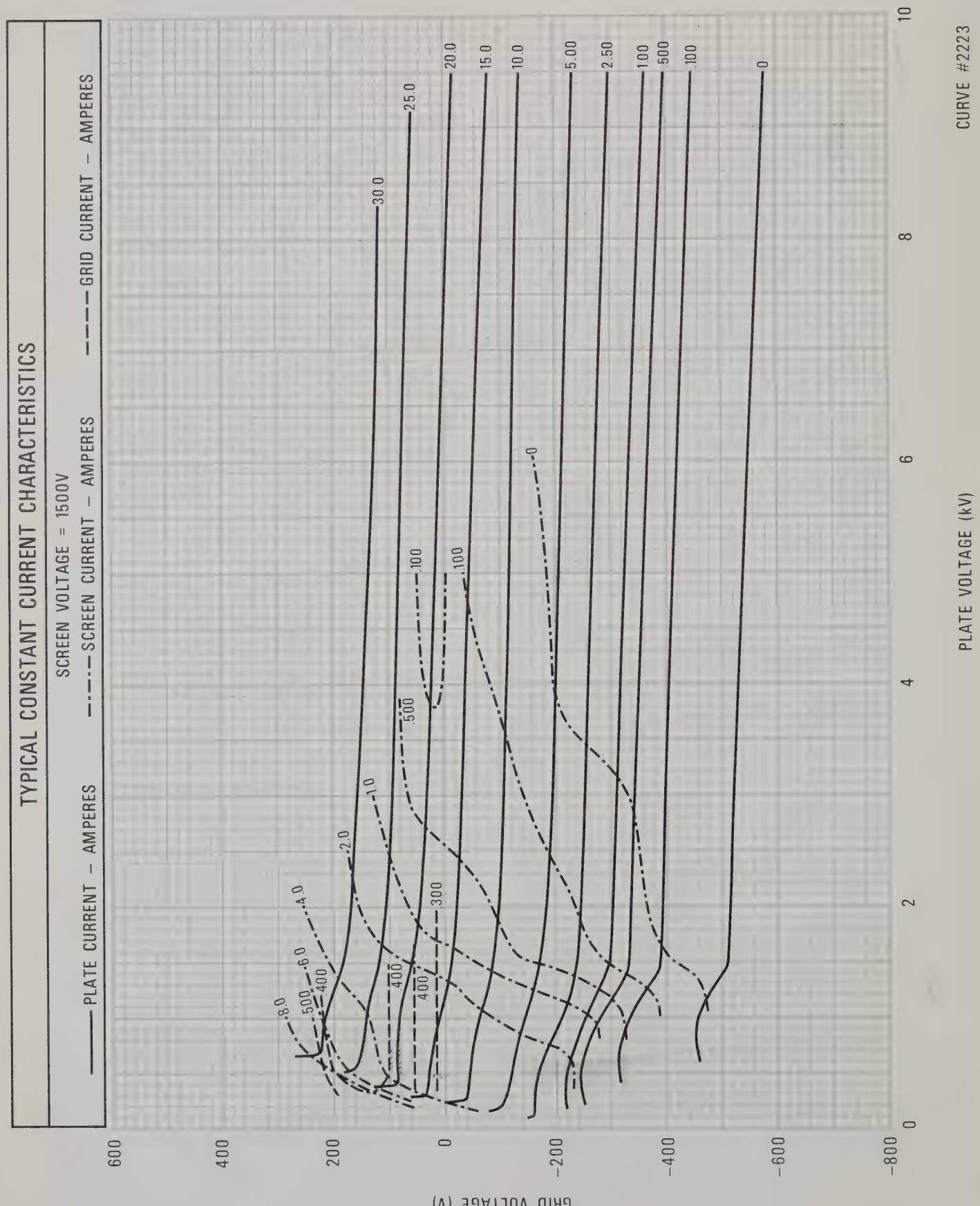
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground".

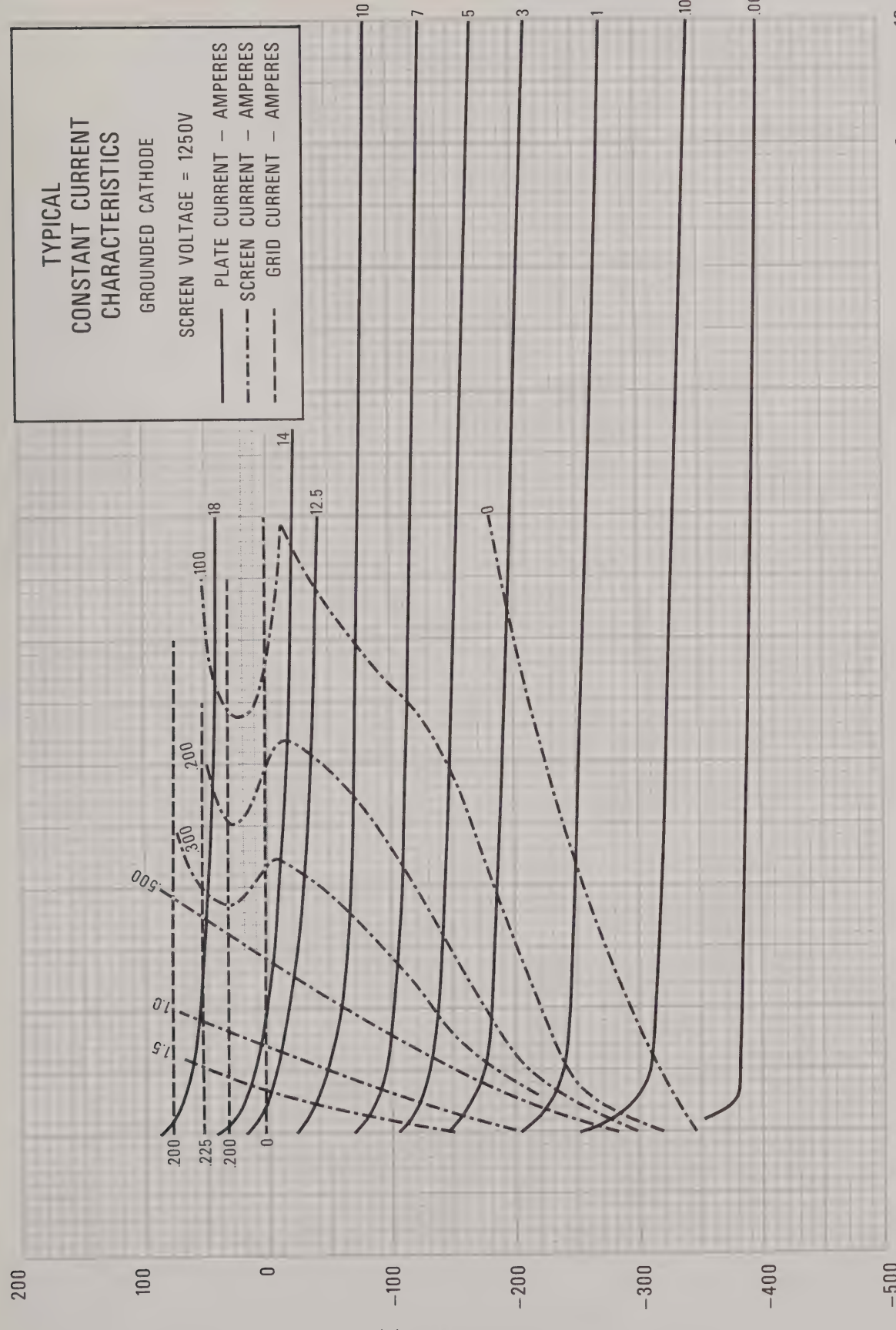
The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Dept., Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070 for information and recommendations.

E_{c2} = 1500V

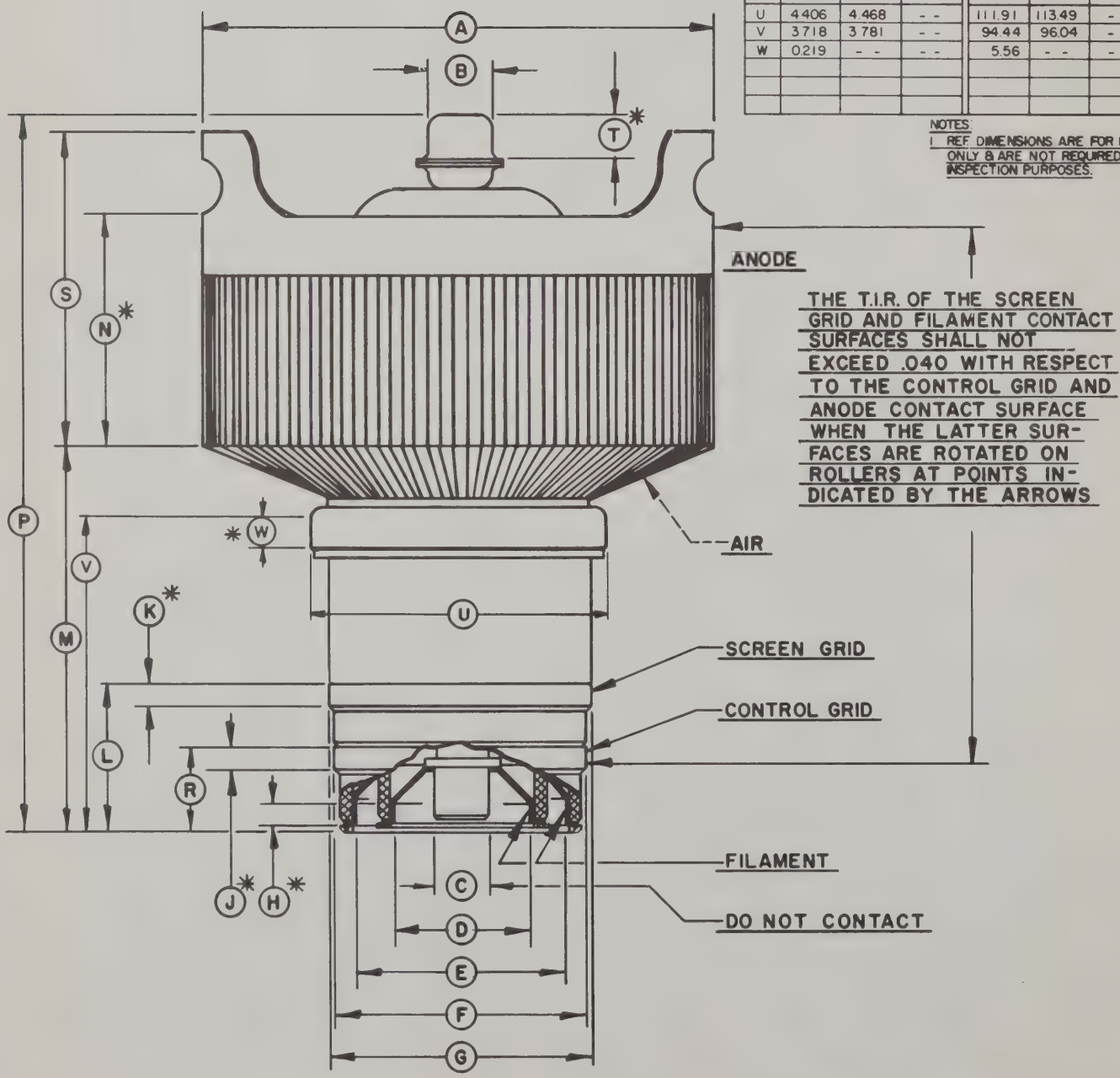

TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 1500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
600
400
200
0
–200
–400
–600
–800
0
2
4
6
8
10
PLATE VOLTAGE (kV)
CURVE #2223
30.0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.500
.100
0
8.0
6.0
4.0
2.0
1.0
.500
.400
.300
.100
0


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 1250V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #3910

DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	7.460	7.580	- -	189.48	192.53	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	46.63	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
G	3.980	4.020	- -	101.09	102.11	- -
H	0.188	- -	- -	4.78	- -	- -
J	0.188	- -	- -	4.78	- -	- -
K	0.188	- -	- -	4.78	- -	- -
L	1.764	1.826	- -	44.81	46.38	- -
M	4.659	4.783	- -	118.34	121.49	- -
N	2.412	2.788	- -	61.26	70.82	- -
P	9.000	9.375	- -	228.60	238.13	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.560	3.684	- -	90.42	93.57	- -
T	0.375	- -	- -	9.53	- -	- -
U	4.406	4.468	- -	111.91	113.49	- -
V	3.718	3.781	- -	94.44	96.04	- -
W	0.219	- -	- -	5.56	- -	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



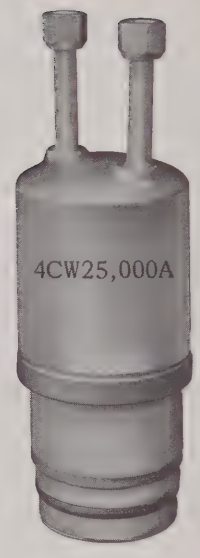
* CONTACT SURFACE

4CW25,000A

RADIAL BEAM
POWER TETRODE

The EIMAC 4CW25,000A is a ceramic/metal power tetrode intended for use in audio or radio frequency applications. It features a new type of internal mechanical structure which results in higher rf operating efficiency. Low rf losses in this mechanical structure permit operation of the 4CW25,000A at full ratings up to 110 MHz, and at reduced ratings, to 225 MHz.

The 4CW25,000A is recommended for radio-frequency linear power amplifier service, for television linear amplifier service, and as a switch tube for pulsed regulator service.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	6.3 ± 0.3 V
Current, at 6.3 volts	160 A
Amplification Factor, average	
Grid to Screen	4.5
Direct Interelectrode Capacitances (cathode grounded):[2]	
Cin	160.0 pF
Cout	24.5 pF
Cgp	1.5 pF
Direct Interelectrode Capacitances (grid and screen grounded):[2]	
Cin	67.0 pF
Cout	25.5 pF
Cpk	0.2 pF
Maximum Frequency Ratings	
CW	110 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	12.69 in; 322.33 mm
Diameter	4.750 in; 120.65 mm
Net Weight	13.5 lb; 6.10 kg
Operating Position	Axis vertical, base up or down
Cooling	Water and Forced Air

(Effective 2-1-72) © by Varian Printed in U.S.A.

Operating Temperature, maximum
Ceramic/Metal Seals and Anode Core ..... 250°C
Base ..... Special, concentric
Recommended Air System Socket SK-300A

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, Class AB_1

ABSOLUTE MAXIMUM RATINGS:

PLATE VOLTAGE	10.0 kVdc
SCREEN VOLTAGE	2.0 kVdc
PLATE CURRENT	6.0 Adc
PLATE DISSIPATION	25.0 kW
SCREEN DISSIPATION	450 W
GRID DISSIPATION	200 W

1. Adjust for specified zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION (Frequencies to 110 MHz)
Peak Envelope or Modulation Crest Conditions

Plate Voltage	7,500	10,000 Vdc
Screen Voltage	1,500	1,500 Vdc
Grid Voltage [1]	-350	-370 Vdc
Zero-Signal Plate Current	1.0	1.0 Adc
Single-Tone Plate Current	4.0	4.25 Adc
Single-Tone Screen Current[2]	170	150 mAdc
Peak rf Grid Voltage [2]	330	340 v
Plate Dissipation	12.2	14.0 kW
Single-Tone Plate Output Power	20.8	28.5 kW
Resonant Load Impedance	865	1,260 Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy of FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

PLATE VOLTAGE	10.0 kVdc
SCREEN VOLTAGE	2.0 kVdc
PLATE CURRENT	5.0 Adc
PLATE DISSIPATION	25.0 kW
SCREEN DISSIPATION	450 W
GRID DISSIPATION	200 W

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	7,500	10,000 Vdc
Screen Voltage	750	750 Vdc
Grid Voltage	-510	-550 Vdc
Plate Current	4.65	4.55 Adc
Screen Current [1]	0.59	0.54 Adc
Grid Current [1]	0.30	0.27 Adc
Peak rf Grid Voltage [1]	730	790 v
Calculated Driving Power	220	220 W
Plate Dissipation	8.1	9.0 kW
Plate Output Power	26.7	36.5 kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER, GRID DRIVEN, Class C Telephony

(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

PLATE VOLTAGE	8.0 kVdc
SCREEN VOLTAGE	1.5 kVdc
PLATE CURRENT	4.0 Adc
PLATE DISSIPATION	16.4 kW
SCREEN DISSIPATION	450 W
GRID DISSIPATION	200 W

1. Approximate value.

TYPICAL OPERATION (Frequencies to 110 MHz)

Plate Voltage	6,000	8,000 Vdc
Screen Voltage	750	750 Vdc
Grid Voltage	-600	-640 Vdc
Plate Current	3.75	3.65 Adc
Screen Current [1]	0.45	0.43 Adc
Grid Current [1]	0.18	0.18 Adc
Peak af Screen Voltage [1] 100% modulation	740	710 v
Peak rf Grid Voltage [1]	800	840 v
Calculated Driving Power	150	150 W
Plate Dissipation	5.1	5.8 kW
Plate Output Power	17.4	23.5 kW

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR, GRID DRIVEN, Class AB_1

(Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

PLATE VOLTAGE	10.0 kVdc
SCREEN VOLTAGE	2.0 kVdc
PLATE CURRENT	6.0 Adc
PLATE DISSIPATION	25.0 kW
SCREEN DISSIPATION	450 W
GRID DISSIPATION	200 W

1. Adjust for specified zero-signal plate current.

TYPICAL OPERATION (Two tubes)

Plate Voltage	7,500	10,000 Vdc
Screen Voltage	1,500	1,500 Vdc
Grid Voltage [1]	-350	-370 Vdc
Zero-Signal Plate Current	1.00	1.00 Adc
Maximum Signal Plate Current	8.80	8.50 Adc
Maximum Signal Screen Current[2]	0.34	0.30 Adc
Peak af Grid Voltage [2]	330	340 v
Maximum Signal Plate Dissipation	12.2	14.0 kW
Plate Output Power	41.6	57.0 kW
Load Resistance (plate to plate)	1,730	2,520 Ω

2. Approximate value.

SWITCH TUBE OR PULSED REGULATOR SERVICE

ABSOLUTE MAXIMUM RATINGS:

PLATE VOLTAGE	20.0 kVdc
SCREEN VOLTAGE	3.0 kVdc
GRID VOLTAGE	-1.5 kVdc
PEAK CATHODE CURRENT	80 a
PEAK ANODE CURRENT	60 a
GRID DISSIPATION [1]	200 W
SCREEN DISSIPATION [1]	450 W
PLATE DISSIPATION [1]	25.0 kW
PULSE LENGTH	See Note 2
DUTY FACTOR	See Note 2

1. Dissipation values shown are average.

2. Duty must be maintained at a low enough level that average tube dissipation ratings are not exceeded. For pulse lengths in excess of 0.1 second, some reduction of electrode dissipation ratings will be required.

TYPICAL OPERATION values are obtained by calculations from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.3 volts	152	168	A
Interelectrode Capacitances, cathode grounded [1]			
Cin	154.0	167.0	pF
Cout	22.0	27.0	pF
Cgp	----	2.0	pF
Interelectrode Capacitances, grid and screen grounded [1]			
Cin	62.0	72.0	pF
Cout	23.0	28.0	pF
Cpk	----	0.3	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CW25,000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC Air-System Socket Type SK-300A is designed especially for the concentric base terminals of the 4CW25,000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube base seal areas.

COOLING - Anode cooling is accomplished by circulating water through the integral anode water jacket. The table below lists the minimum cooling water requirements at various dissipation levels.

Plate *Dissipation (kilowatts)	Water Flow GPM	Approx. Pressure Drop PSI
10	2.2	3.3
15	3.0	5.0
20	4.0	8.0
25	5.0	11.5

*Since the power dissipated by the filament represents about 1000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 600 watts, allowance has been made in preparing this tabulation for an additional 1600 watts dissipation.

The cooling table assumes a water temperature rise of 20°C. Under no circumstances should the outlet water temperature exceed 70°C. Inlet water pressure should not exceed 50 PSI.

A major factor effecting long life of water cooled tubes is the condition of the cooling water.

A simple method of determing the condition of the water is to measure the resistance across a measured amount. This can be accomplished by inserting two electrodes into the water through an insulted section of water line and measuring the resistance between the two electrodes with a sensitive meter. The resistance of the water should be maintained above 50 kohms/cm^3.

Separate cooling of the tube base is required and is accomplished by directing approximately 50 cfm of air at sea level through the socket.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 4CW25,000A is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

ELECTRODE DISSIPATION RATINGS - The maximum dissipation ratings for the 4CW25,000A must be respected to avoid damage to the tube. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

GRID OPERATION - The 4CW25,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

SCREEN OPERATION - The power dissipated by the screen of the 4CW25,000A must not exceed 450 watts.

Screen dissipation, in cases where there is no AC applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 450 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CW25,000A is 25,000 watts.

When the 4CW25,000A is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 25,000 watt maximum plate dissipation rating will be exceeded.

HIGH VOLTAGE - Normal operating voltages used with the 4CW25,000A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CW25,000A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

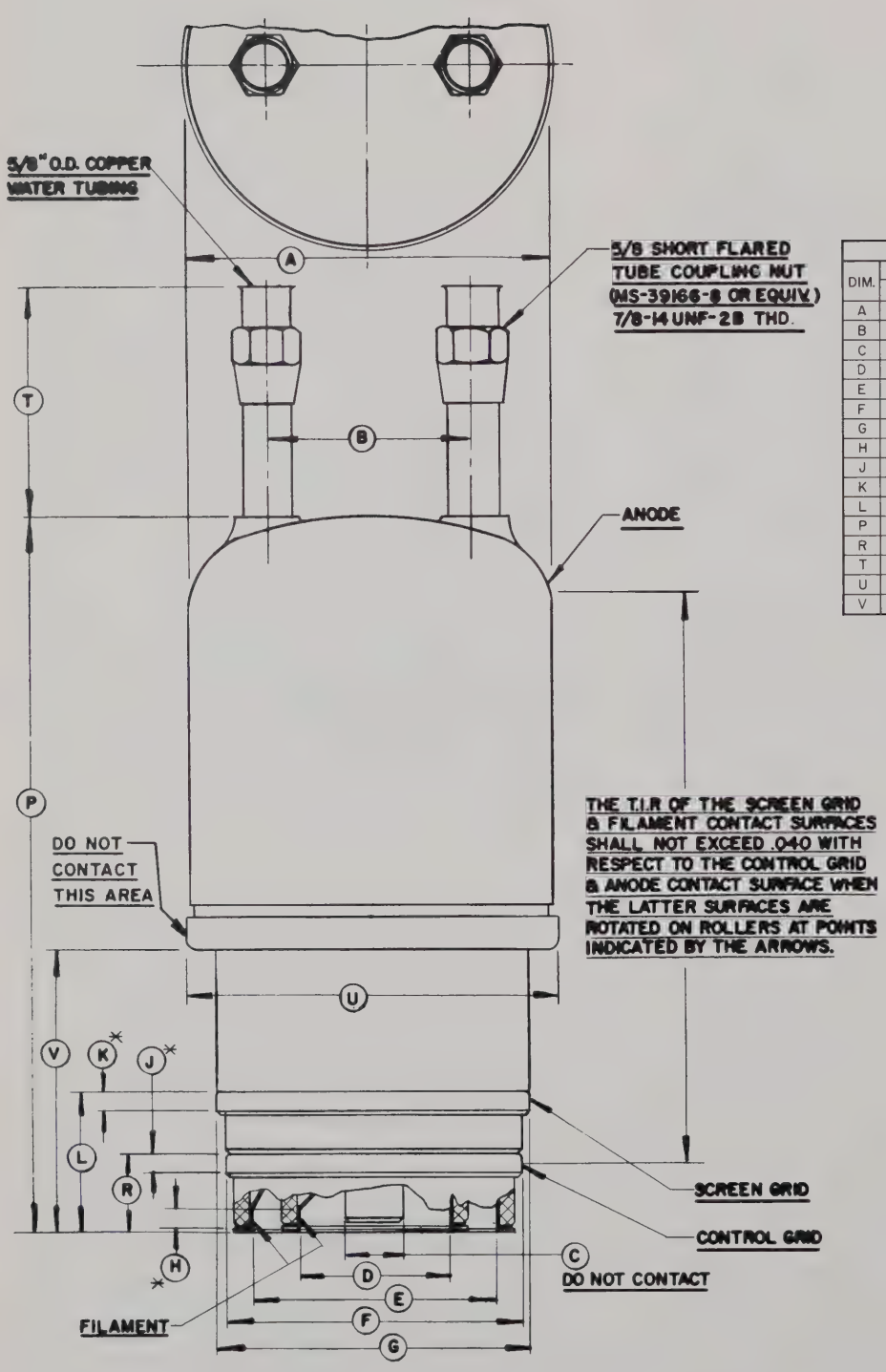
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 4CW-25,000A, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

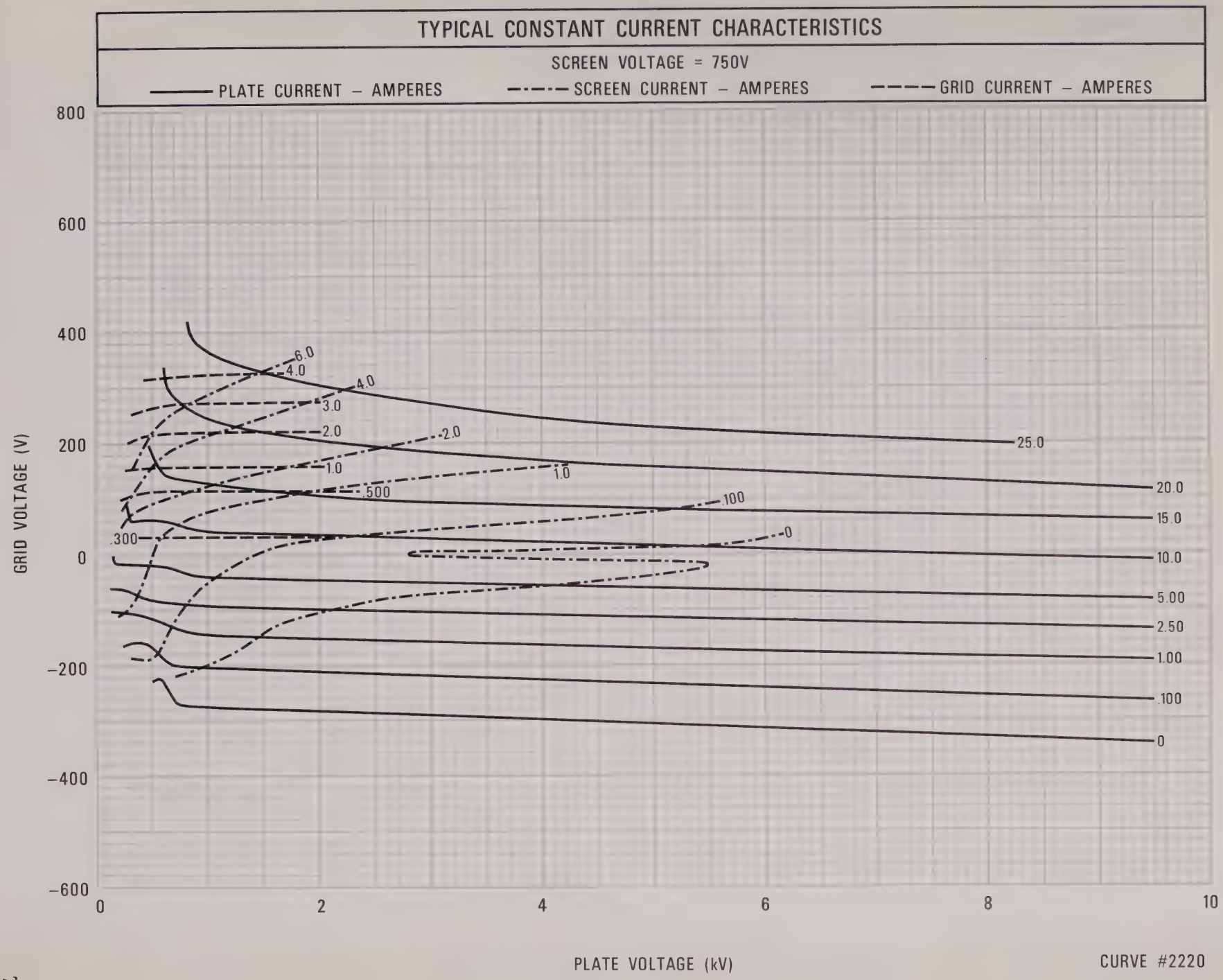
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Dept., Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California, 94070 for information and recommendations.

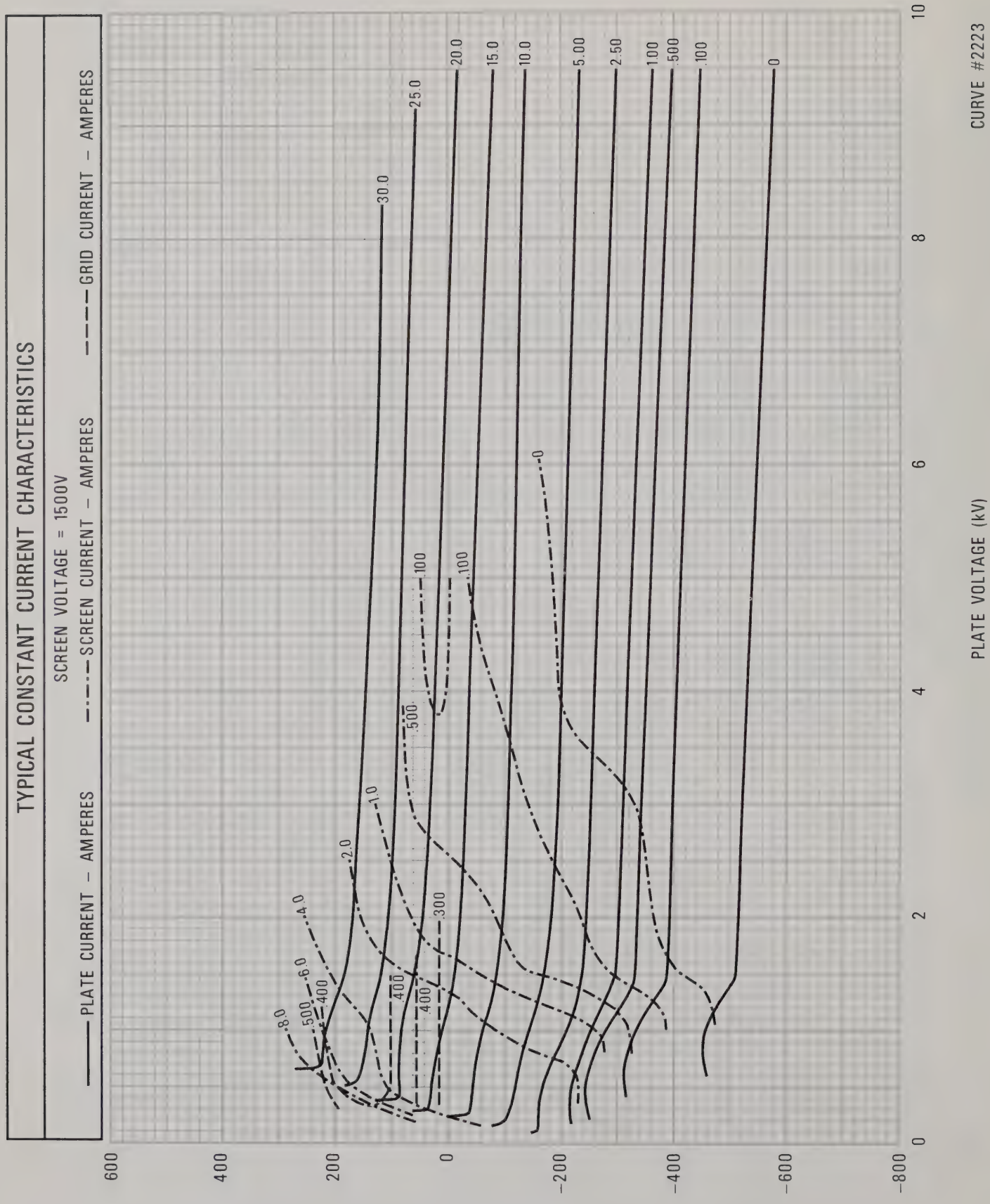


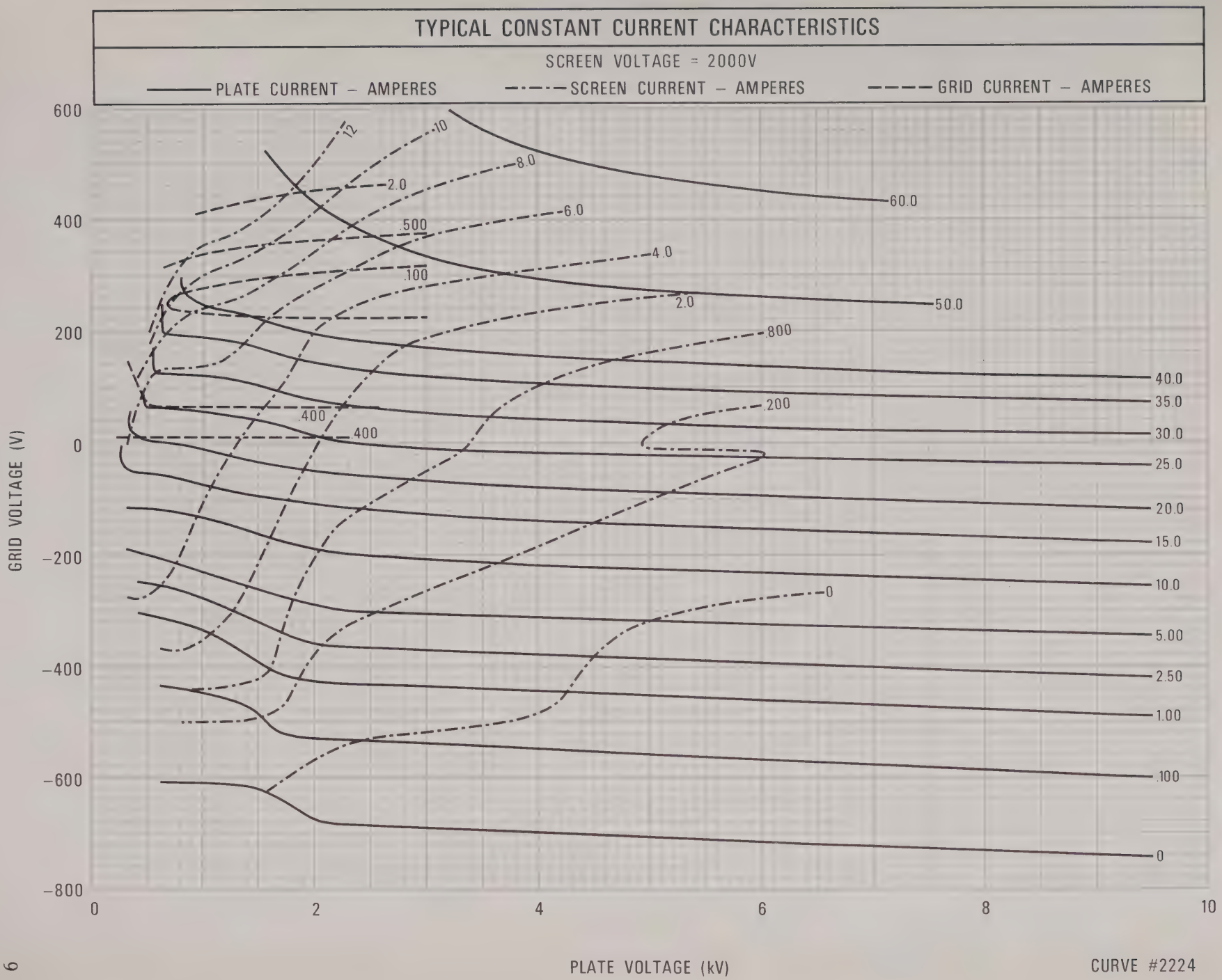
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.570	4.630	--	116.08	117.60	--
B	2.625	2.875	--	66.67	73.02	--
C	.720	.760	--	18.29	19.30	--
D	1.896	1.936	--	48.16	49.17	--
E	3.133	3.173	--	79.58	80.59	--
F	3.792	3.832	--	96.32	97.33	--
G	3.980	4.020	--	101.09	102.11	--
H	.188	--	--	4.77	--	--
J	.188	--	--	4.77	--	--
K	.188	--	--	4.77	--	--
L	1.764	1.826	--	44.80	46.38	--
P	9.065	9.565	--	230.25	242.95	--
R	.986	1.050	--	25.04	26.67	--
T	2.875	3.125	--	73.02	79.37	--
U	--	4.750	--	--	120.65	--
V	3.625	3.675	--	92.07	93.34	--

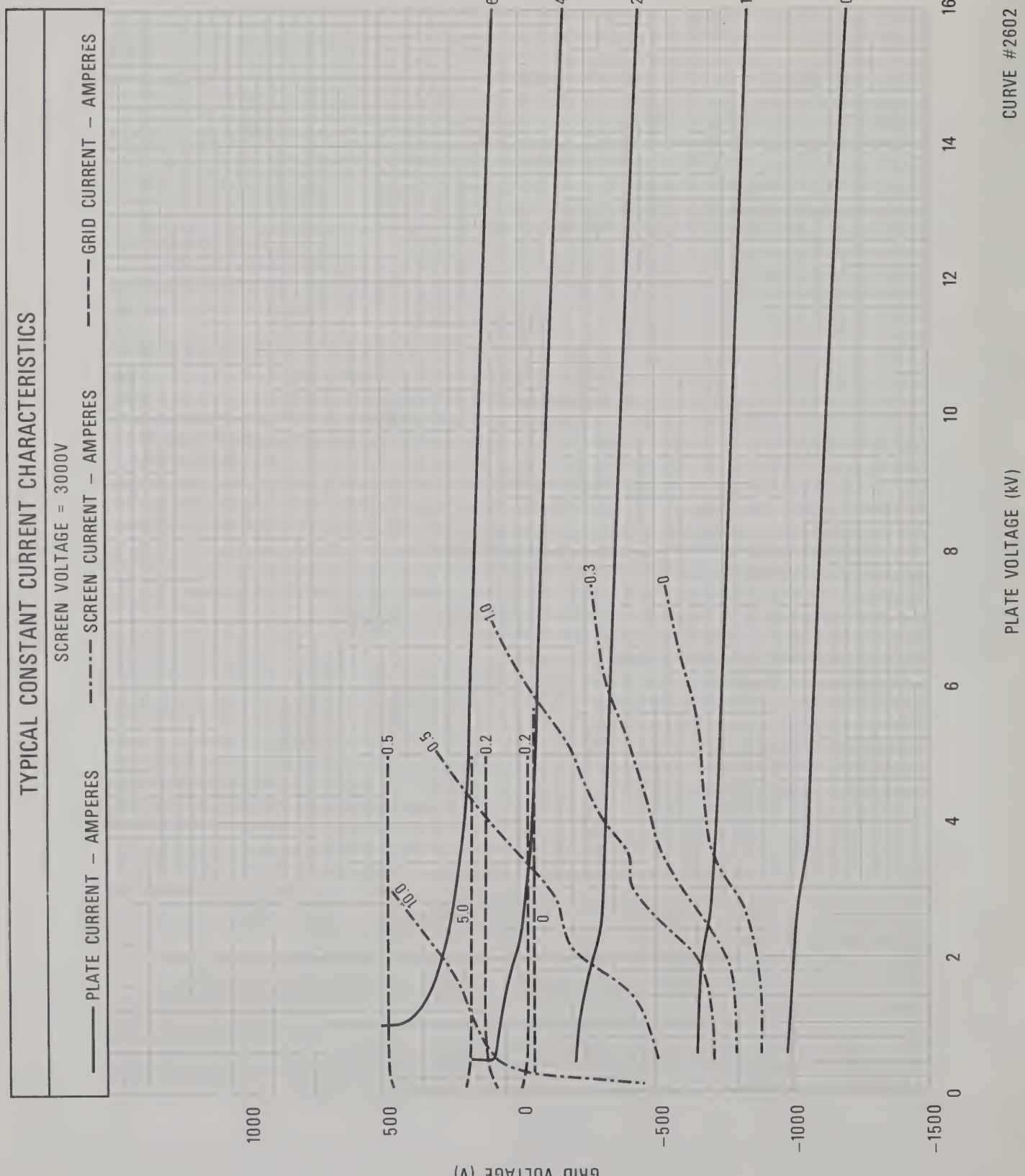
NOTES:

1. (*) CONTACT SURFACE
2. REF. DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.


TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 750V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
PLATE VOLTAGE (kV)
6.0
4.0
4.0
3.0
2.0
2.0
1.0
1.0
.500
.300
.100
0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0
CURVE #2220


TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 1500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #2223
600
400
200
0
-200
-400
-600
-800
0
2
4
6
8
10
30.0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.500
.100
0
8.0
6.0
4.0
2.0
1.0
.500
.400
.300
.100
.500
.400
.100
0


TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 2000V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
600
400
200
0
−200
−400
−600
−800
0
2
4
6
8
10
PLATE VOLTAGE (kV)
CURVE #2224
12
10
8.0
6.0
4.0
2.0
.500
.100
.400
.800
.200
0
60.0
50.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0


TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 3000V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
60.0
40.0
20.0
1.0
0
-0.5
-0.2
-0.2
-0.3
-0
10.0
5.0
0.5
1.0
5.0
0
1000
500
0
-500
-1000
-1500
GRID VOLTAGE (V)
0
2
4
6
8
10
12
14
16
PLATE VOLTAGE (KV)
CURVE #2602

4CW50,000J

TECHNICAL DATA

WATER COOLED
POWER TETRODE

The EIMAC 4CW50,000J is a ceramic/metal, liquid-cooled power tetrode intended for use at the 50 to 100 kilowatt output power level. This tube is characterized by low input and feedback capacitances and low internal lead inductances. A rugged mesh thoriated tungsten filament provides adequate emission over the long operating life. It is recommended for use as a Class AB_1 rf linear amplifier. The liquid-cooled anode is rated at 50 kilowatts plate dissipation.



Shown with SK-2050 Jacket
(order separately)

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Mesh Thoriated Tungsten	
Voltage	12.0 ± 0.6 V
Current, at 12.0 volts	220 A
Amplification Factor (Average):	
Grid to Screen	4.5
Direct Interelectrode Capacitances (grounded cathode):	
Cin	310 pF
Cout	48 pF
Cgp	1.0 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

MECHANICAL

Maximum Overall Dimensions:	
Length (with water jacket)	12.75 in; 324 mm
Diameter	9.53 in; 242 mm
Net Weight (less water jacket)	35 lb; 15.9 kg
Operating Position	Vertical, base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals and terminals	250°C
Cooling	Liquid and Forced Air
Base	Special
Recommended Socket	EIMAC SK-2000 Series
Recommended Water Jacket	EIMAC SK-2050

(Effective 7-15-71) © 1971 Varian Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION	50,000	WATTS
SCREEN DISSIPATION	1,500	WATTS
GRID DISSIPATION	400	WATTS

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.
3. The IMD products are referenced against one tone of a two-equal tone signal.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB1, Grid Driven
Peak Envelope or Modulation Crest Conditions

Plate Voltage	8.3	kVdc
Screen Voltage	1.5	kVdc
Grid Voltage [1]	-250	Vdc
Zero-Signal Plate Current	3.6	Adc
Single-Tone Plate Current	9.8	Adc
Peak rf Grid Voltage[2]	250	v
Resonant Load Impedance	413	Ω
Plate Dissipation	35	kW
Plate Output Power	45	kW
Intermod. Distortion Products [3]		
3rd Order	-46	dB
5th Order	-60	dB

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 12.0 volts	200	230	A
Interlectrode Capacitances (grounded cathode connection)			
Cin	290	330	pF
Cout	42.0	53.0	pF
Cgp	---	1.5	pF
Interelectrode Capacitances (grounded grid connection)			
Cin	113	137	pF
Cout	45.0	55.0	pF
Cgk	---	0.5	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CW50,000J must be operated with its axis vertical. The base of the tube may be up or down at the convenience of the circuit designer.

SOCKET - The EIMAC socket type SK-2000 is recommended for use with the 4CW50,000J.

COOLING - Anode cooling is accomplished by circulating water through the SK-2050 water jacket. The table below lists minimum cooling water requirements at various dissipation levels.

Plate Dissipation* (kilowatts)	Water Flow (GPM)	Pressure Drop (PSI)
10	3.0	2.0
20	5.0	3.0
30	6.5	4.0
40	8.5	5.2
50	10.5	6.5

*Since the power dissipated by the filament represents about 2500 watts and since grid-plus-screen dissipation can, under some conditions, represent another 1900 watts, allowance has been made in preparing this tabulation for an additional 4400 watts dissipation.

The cooling table above assumes a water temperature rise of 20°C. Under no circumstances should the outlet water temperature exceed 70°C. Inlet water pressure should not exceed 100 psi.

A major factor affecting long life of water cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 K ohms/cm^3, and preferably above 250 K ohms/cm^3. A relative water resistance check can be made continuously by measuring the leakage current which will bypass a short section of the insulating hose column if metal nipples or fittings are used as electrodes.

Separate cooling of the tube base is required and is accomplished by directing approximately 200 cfm of air through the socket.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the socket with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 4CW50,000J is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CW50,000J by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CW50,000J. At some point in filament voltage there will be noticeable reduction in plate current, or power output, or an increase in distortion. Operation must be at a filament voltage slightly higher than the point at which performance appears to deteriorate. This point should be periodically checked to maintain proper operation.

GRID OPERATION - The 4CW50,000J control grid is rated at 400 watts of dissipation. Grid dissipation is the approximate product of grid current and peak positive grid voltage.

SCREEN DISSIPATION - The power dissipated by the screen grid must not exceed 1500 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is dependent on rms screen voltage, and rms screen current. Plate voltage, plate load or bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

The 4CW50,000J may exhibit reversed screen current to a greater or lesser degree depending on operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished with a bleeder resistor connected from screen to cathode, or an electron-tube regulator circuit may be employed in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed.

PLATE DISSIPATION - The plate dissipation of 50 kilowatts attainable through water cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CW50,000J is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 33,300 watts.

STANDBY OPERATION - Coolant must be circulated through the anode water jacket whenever filament power is applied even though no other voltages are present. Sixty to eighty percent of the filament power appears as heat in the anode. In the absence of coolant flow, temperatures will rise to levels which are detrimental to long life. If the coolant lines are obstructed the coolant jacket may rupture from the generated steam pressure.

HIGH VOLTAGE - Normal operating voltages used with the 4CW50,000J are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher that 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CW50,000J, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are effected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

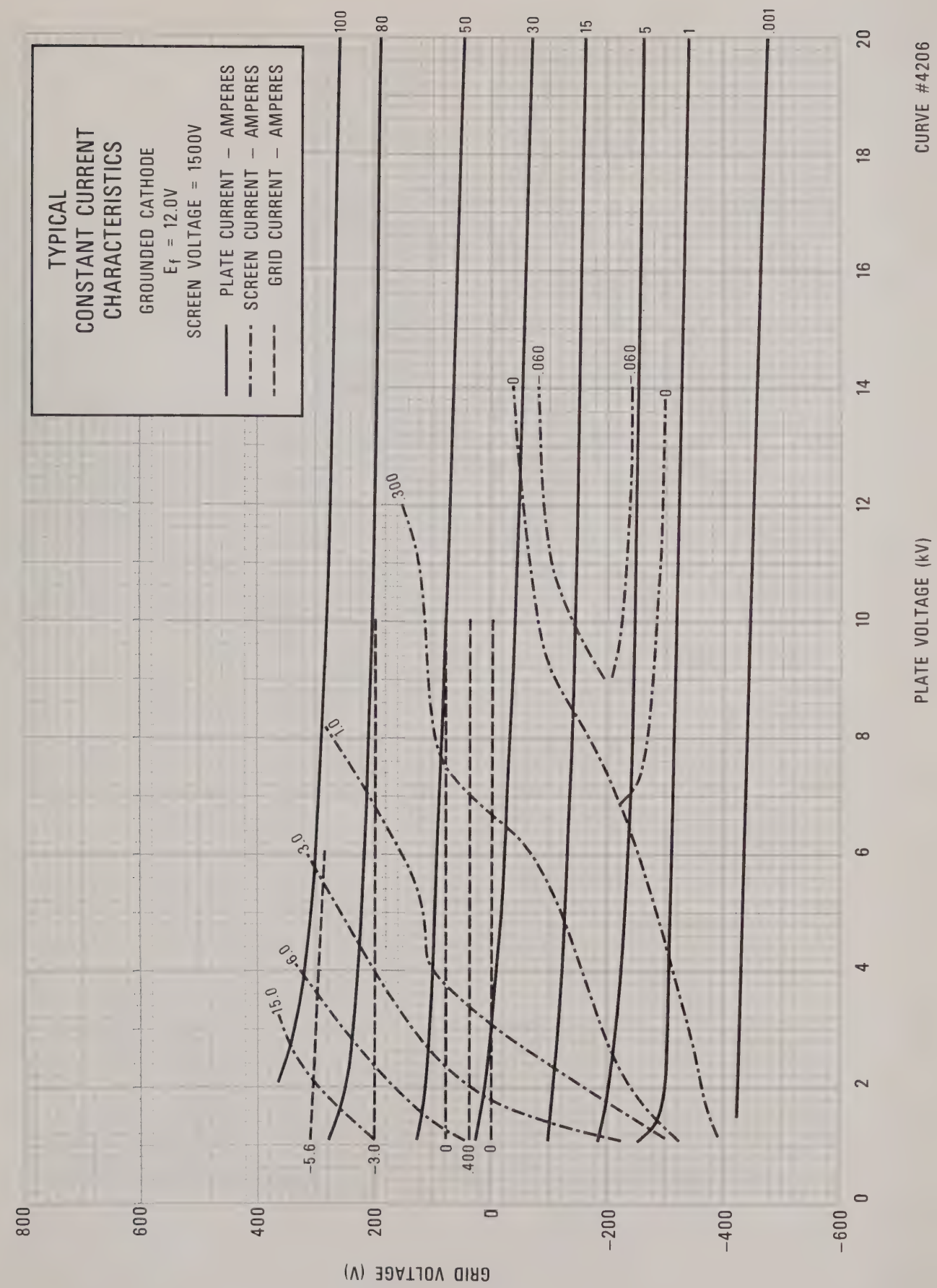
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

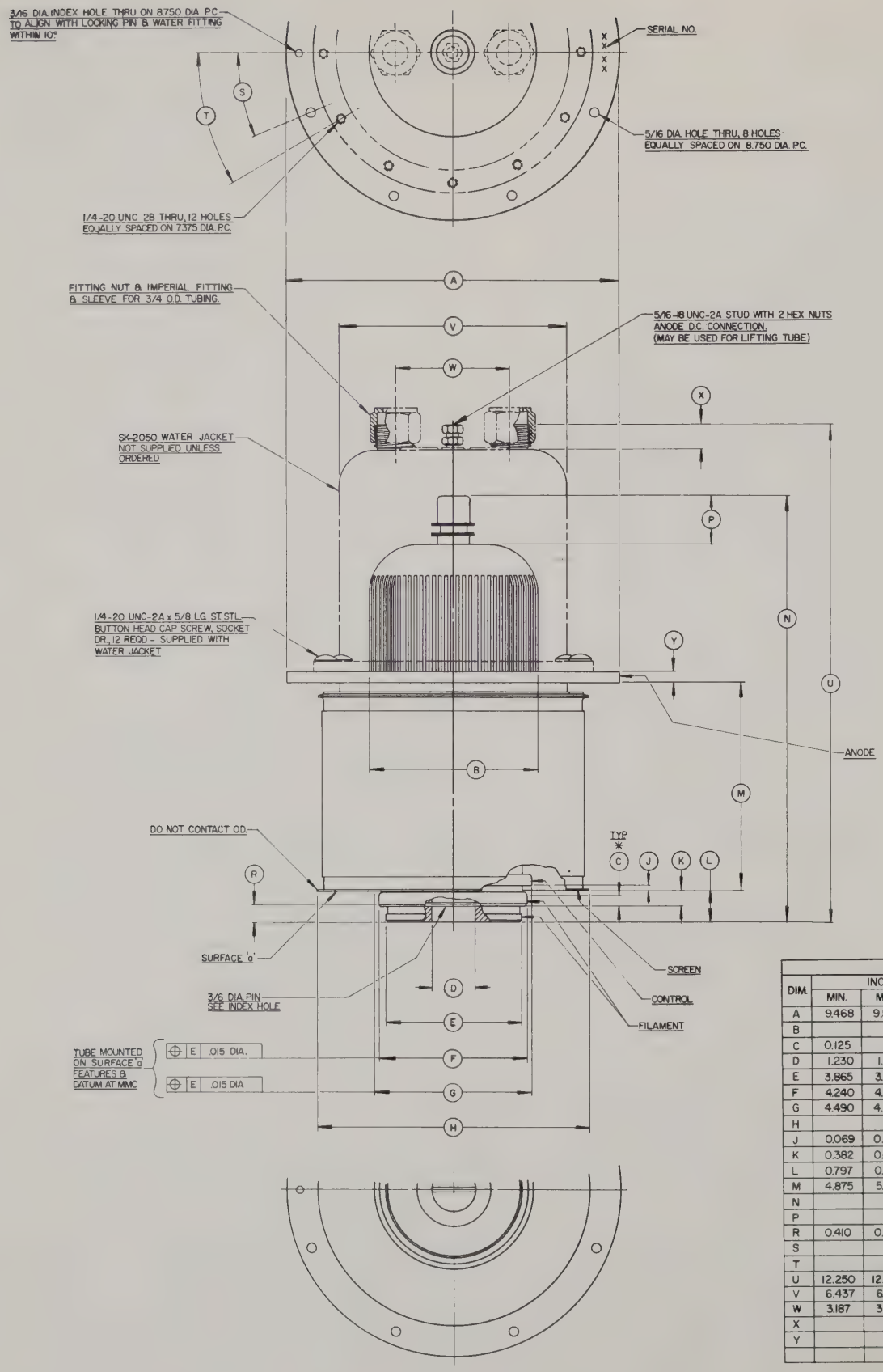
Many EIMAC power tubes, such as the 4CW-50,000J, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

FAULT PROTECTION - In addition to normal plate over-current interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 12.0V
SCREEN VOLTAGE = 1500V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
100
80
50
30
15
5
1
.001
.300
.060
.060
0
0
0
.400
-15.0
-6.0
-3.0
-1.0
-.3.0
-5.6
-3.0
800
600
400
200
0
-200
-400
-600
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #4206



DIM.	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF	MIN.	MAX.	REF
A	9.468	9.531		240.49	242.09	
B			5.000			127.00
C	0.125			3.18		
D	1.230	1.270		31.24	32.26	
E	3.865	3.885		98.17	98.68	
F	4.240	4.260		107.70	108.20	
G	4.490	4.510		114.05	114.55	
H			7.750			196.85
J	0.069	0.149		1.75	3.78	
K	0.382	0.462		9.70	11.73	
L	0.797	0.922		20.24	23.42	
M	4.875	5.000		123.83	127.00	
N			11.500			292.10
P			1.437			36.50
R	0.410	0.475		10.41	12.07	
S			22.5°			22.5°
T			30°			30°
U	12.250	12.750		311.15	323.85	
V	6.437	6.562		163.50	166.67	
W	3.187	3.313		80.95	84.15	
X			0.562			14.27
Y			0.312			7.92

NOTES
1. REF DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

8350
4CW50,000C

RADIAL-BEAM POWER TETRODE



The Eimac 8350/4CW50,000C is a ceramic-metal, water cooled power tetrode intended for use at the 50 to 150 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB, rf linear amplifier or a Class-AB, push-pull af amplifier or modulator. The 8350/4CW50,000C is also useful as a plate and screen modulated Class-C rf amplifier.

The water cooled anode is rated at 50 kilowatts of plate dissipation with low water flow requirements.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament:	Thoriated Tungsten	
	Voltage	10 volts
	Current	300 amps
	Amplification Factor (Grid-Screen) (average)	4.5

Direct Interelectrode Capacitances, Grounded Cathode:

Input	430 uuf
Output	45 uuf
Feedback	2.3 uuf

Frequency for Maximum Ratings: 30 Mc

MECHANICAL

Base	Special, graduated rings
Maximum Seal Temperature	250°C
Maximum Anode Core Temperature	250°C
Recommended Socket	Eimac, SK-1500
Operating Position	Vertical, base up or down

Maximum Dimensions:

Height	16.5 inches
Diameter	8.02 inches
Cooling	Water and Forced air
Net Weight	60 pounds
Shipping Weight (approximately)	85 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	50,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	10	15	20 kV
DC Screen Voltage	750	750	750 volts
DC Grid Voltage	-420	-480	-540 volts
DC Plate Current	10.7	10.5	9.7 amps
DC Screen Current	2.25	2.1	1.65 amps
DC Grid Current	1.2	1.15	.89 amps
Peak RF Grid Voltage	680	740	790 volts
Driving Power	815	850	705 volts
Plate Dissipation	23	32	30 kW
Plate Output Power	84	124	165 kW

Note: Maximum plate voltage and plate current cannot be applied simultaneously without exceeding dissipation ratings.

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PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	15,000 MAX. VOLTS
DC SCREEN VOLTAGE	2000 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION*	33,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

*Corresponds to 50,000 watts at 100 percent sinewave modulation

TYPICAL OPERATION

DC Plate Voltage	10	12.5	15 kV
DC Screen Voltage	750	750	750 volts
Peak AF Screen Voltage (For 100% modulation)	705	675	745 volts
DC Grid Voltage	-490	-500	-510 volts
DC Plate Current	7.4	8.15	8.95 amps
DC Screen Current	1.2	1.4	1.55 amp
DC Grid Current	.470	.650	.790 amp
Peak RF Grid Voltage	670	710	730 volts
Grid Driving Power	315	460	570 watts
Plate Dissipation	14	18.5	24 kW
Plate Output Power	60	83.5	110 kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	50,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

* Per Tube

**Approximate value

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	10	15	20 kV
DC Screen Voltage	1.5	1.5	1.5 kV
DC Grid Voltage	-280	-320	-360 volts
Max-Signal Plate Current	18.4	16.4	17.3 amps
Zero-Signal Plate Current	6.0	4.0	3.0 amps
Max-Signal Screen Current**	.780	.550	.500 amp
Zero-Signal Screen Current	0	0	0 amps
Peak AF Driving Voltage*	260	300	340 volts
Driving Power	0	0	0 watts
Load Resistance, Plate-to-Plate	1140	1980	2590 ohms
Max-Signal Plate Dissipation*	35	38	48 kW
Max-Signal Plate Output Power	114	170	250 kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	50,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

*Approximate value

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions.

DC Plate Voltage	10	15	20 kV
DC Screen Voltage	1.5	1.5	1.5 kV
DC Grid Voltage	-280	-320	-360 volts
Max-Signal Plate Current	9.2	8.2	8.65 amps
Zero-Signal Plate Current	3.0	2.0	1.5 amp
Max-Signal Screen Current*	.390	.275	.250 amp
Peak RF Grid Voltage	260	300	340 volts
Driving Power	0	0	0 watts
Plate Dissipation	35	38	48 kW
Plate Output Power	57	85	125 kW
Resonant Load Impedance	570	990	1295 ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance is made for circuit losses of any kind. Adjustment of the RF grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct RF driving voltage is applied.

APPLICATION

MECHANICAL

MOUNTING — The 4CW50,000C must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET —The Eimac SK-1500 socket is recommended for use with the 4CW50,000C. Base cooling is accomplished by directing 50-100 CFM of air horizontally into the socket from the side. Temperature of the ceramic-metal seals must be limited to 250°C.

COOLING —Anode cooling is accomplished by circulating water through the integral anode-water jacket. A new more efficient design assures adequate cooling with low water flow rates. The table below lists minimum cooling water requirements at various dissipation levels.

Plate Dissipation* (kilowatts)	Water Flow GPM
20	7.2
30	10.2
40	12.9
50	15.2

*Since the power dissipated by the filament represents about 3000 watts and since grid-plus screen dissipation can, under some conditions, represent another 2250 watts, allowance has been made in preparing this tabulation for an additional 5250 watts dissipation.

The cooling table above assumes a water temperature rise of 20° C. Under no circumstances should the outlet water temperature exceed 70° C. Inlet water pressure should not exceed 75 psi. The pressure drop across the anode at full flow is less than 5 psi.

When the tube is mounted in the anode-up position, cooling water must enter the anode-water jacket through the outer connector; the outlet being the center connector; when the tube is mounted in an inverted position (base up) these connections are reversed, that is, the inlet connection is on the center water fitting and the water outlet is connected to the outer anode fitting.

Water flow must be started before applying any voltages to the tube. Water-flow and water temperature interlock switches are suggested for incorporation in any system to prevent tube damage due to inadequacy of flow. It is not necessary to continue water flow after the removal of all power.

ELECTRICAL

FILAMENT OPERATION —The rated filament voltage for the 4CW50,000C is 10.0 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus 5 percent from the rated value.

ELECTRODE DISSIPATION RATINGS —The maximum dissipation ratings for the 4CW50,000C must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

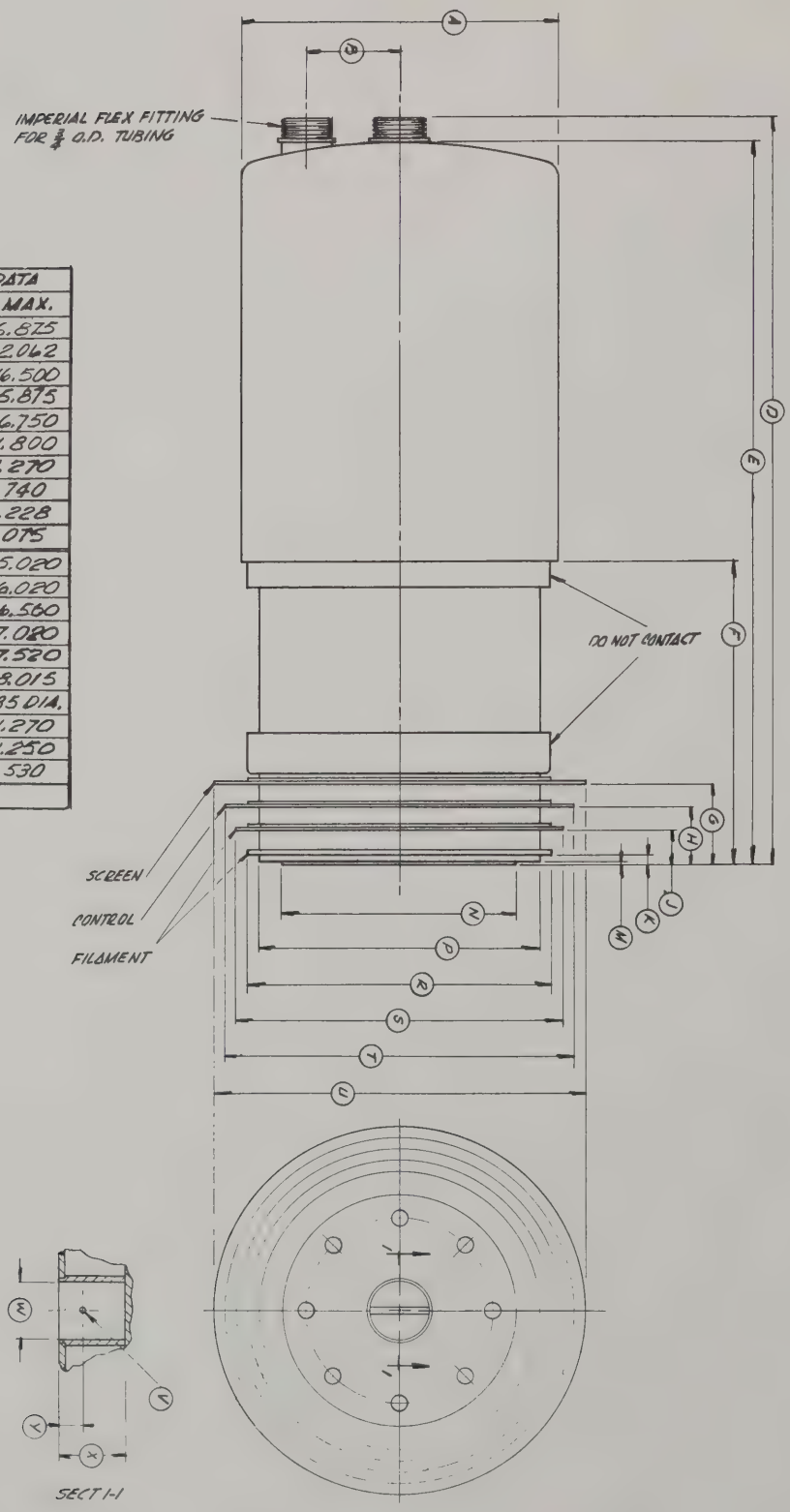
PLATE DISSIPATION — The plate-dissipation rating for the 4CW50,000C is 50,000 watts for most applications, but for Class C plate modulated applications, the maximum allowable dissipation is 33,000 watts for carrier conditions.

CONTROL-GRID OPERATION — The 4CW50,000C control grid has a maximum dissipation rating of 500 watts. Grid dissipation is the product of dc grid current and peak positive grid voltage. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

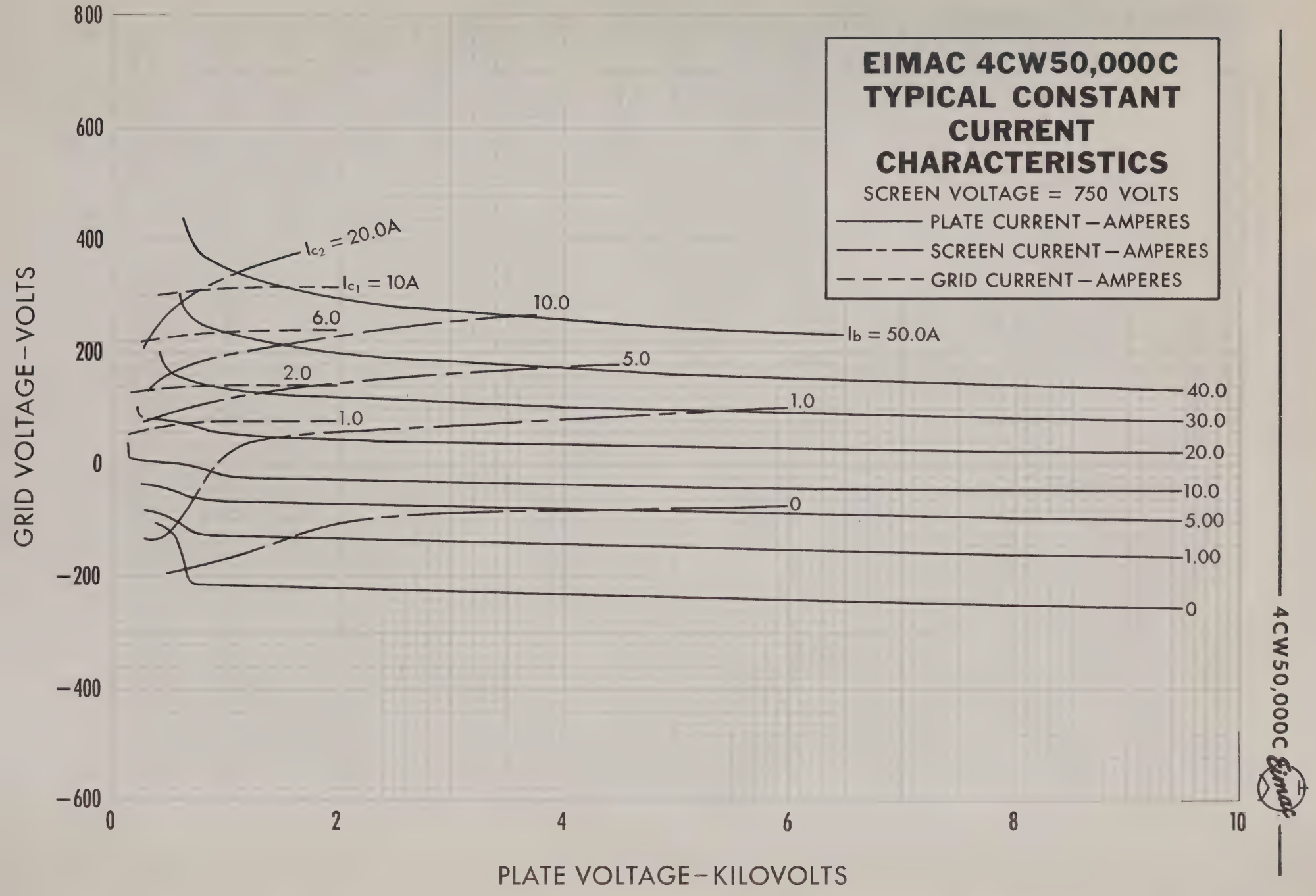
SCREEN-GRID OPERATION — The power dissipated by the screen of the 4CW50,000C must not exceed 1750 watts. Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

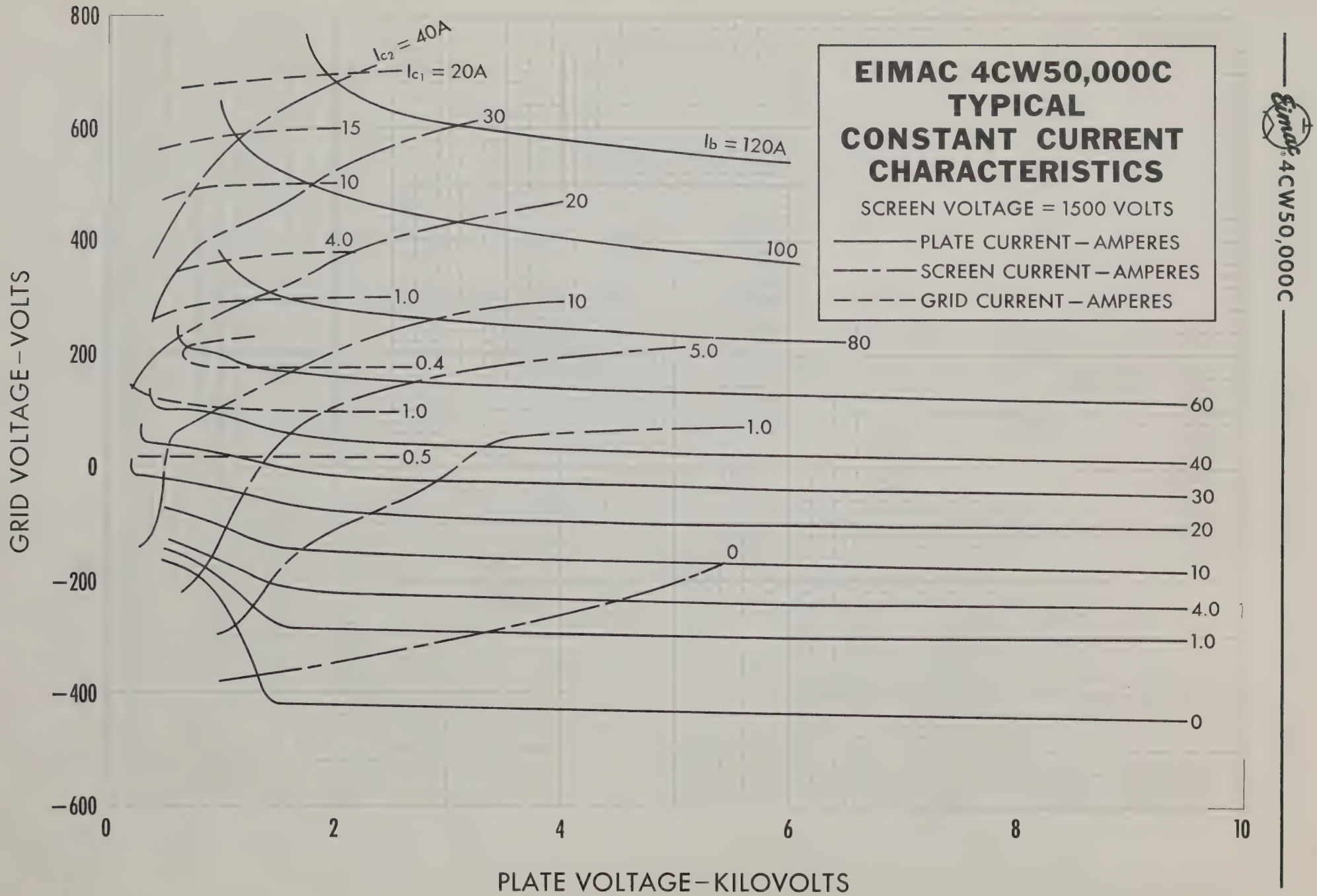
Screen Dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 1750 watts in the event of circuit failure.

SPECIAL APPLICATIONS — If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California for information and recommendations.



DIMENSION DATA		
REF	MIN.	MAX.
A	6.750	6.875
B	1.968	2.062
D	16.000	16.500
E	15.500	15.875
F	6.500	6.750
G	1.750	1.800
H	1.220	1.270
J	.690	.740
K	.188	.228
M	.045	.075
N	4.980	5.020
P	5.980	6.020
R	6.510	6.560
S	6.980	7.080
T	7.480	7.520
U	7.925	8.015
V		.135 DIA.
W	1.250	1.270
X		1.250
Y	.490	.530


EIMAC 4CW50,000C
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
800
600
400
200
0
−200
−400
−600
GRID VOLTAGE – VOLTS
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
I_{c_2} = 20.0A
I_{c_1} = 10A
I_b = 50.0A
10.0
6.0
5.0
2.0
1.0
1.0
0
40.0
30.0
20.0
10.0
5.00
1.00
0
4CW50,000C
Eimac


EIMAC 4CW50,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
I_{c2} = 40A
I_{c1} = 20A
I_b = 120A
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
15
10
4.0
1.0
0.4
1.0
0.5
30
20
10
5.0
1.0
0
100
80
60
40
30
20
10
4.0
1.0
0
Eimac 4CW50,000C

EIMAC
Division of Varian

4CW50,000E

WATER COOLED POWER TETRODE

The EIMAC 4CW50,000E is a ceramic/metal, liquid-cooled power tetrode intended for use at the 50 to 100 kilowatt output power level. This tube is characterized by low input and feedback capacitances and low internal lead inductances. A rugged mesh thoriated tungsten filament provides adequate emission over the long operating life. It is recommended for use as a Class C rf amplifier or oscillator, a Class AB rf linear amplifier or a Class AB push-pull af amplifier or modulator. The 4CW50,000E is also useful as a plate and screen modulated Class C rf amplifier. The liquid-cooled anode is rated at 50 kilowatts plate dissipation.



Shown with SK-2050 water jacket removed.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Mesh Thoriated Tungsten		
Voltage	12.0 ± 0.6	V
Current, at 12.0 volts	220	A
Amplification Factor (Average);		
Grid to Screen	4.5	
Direct Interelectrode Capacitances (grounded cathode)		
Input	310	pF
Output	53	pF
Feedback	0.7	pF
Frequency of Maximum Rating:		
CW	110	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

MECHANICAL

Maximum Overall Dimensions:	
Length (with water jacket)	12.75 in; (324 mm)
Diameter	9.53 in; (242 mm)
Net Weight (less water jacket)	35 lb; (15.9 kg)
Operating Position	Vertical, base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals and terminals	250°C
Cooling	Liquid and Forced air
Base	Special
Recommended Socket	EIMAC SK-2000 Series
Recommended Water Jacket	EIMAC SK-2050

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RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION	50,000	WATTS
SCREEN DISSIPATION	1,500	WATTS
GRID DISSIPATION	400	WATTS

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions.

Plate Voltage	10.0	kVdc
Screen Voltage	1.8	kVdc
Grid Voltage [1]	-260	Vdc
Zero-Signal Plate Current	3.4	Adc
Single Tone Plate Current	9.14	Adc
Peak rf Grid Voltage 2	230	v
Resonant Load Impedance	600	Ω
Plate Dissipation	35	kW
Plate Output Power	57	kW

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION	50,000	WATTS
SCREEN DISSIPATION	1,500	WATTS
GRID DISSIPATION	400	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	15.0	15.0	kVdc
Screen Voltage	1.5	1.5	kVdc
Grid Voltage	-800	-800	Vdc
Plate Current	9.0	11.5	Adc
Screen Current [1]	0.9	0.83	Adc
Grid Current [1]	125	160	mAdc
Peak rf Grid Voltage [1]	880	925	v
Calculated Driving Power [1]	110	150	W
Plate Dissipation	25	36	kW
Plate Output Power	110	137	kW
Resonant Load Impedance	820	615	Ω

1. Approximate value

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	15,000	VOLTS
DC SCREEN VOLTAGE	2,000	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION [1]	33,000	WATTS
SCREEN DISSIPATION [2]	1,500	WATTS
GRID DISSIPATION [2]	400	WATTS

1. Corresponds to 50,000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	9.0	14.0	kVdc
Screen Voltage	750	750	Vdc
Grid Voltage	-600	-600	Vdc
Plate Current	7.41	9.25	Adc
Screen Current [3]	0.69	1.15	Adc
Grid Current	0.333	0.833	Adc
Peak af Screen Voltage 3 (100% modulation)	750	750	v
Peak rf Grid Voltage 3	750	820	v
Calculated Driving Power	250	685	W
Plate Dissipation	12.5	21.5	kW
Plate Output Power	54.2	110	kW

3. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_1, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	12.0	AMPERES
PLATE DISSIPATION	50,000	WATTS
SCREEN DISSIPATION	1,500	WATTS
GRID DISSIPATION	400	WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	15.0	kVdc
Screen Voltage	1.25	kVdc
Grid Voltage [1/3]	-280	Vdc
Zero-Signal Plate Current	5.0	Adc
Max. Signal Plate Current	18.6	Adc
Max. Signal Screen Current [1]	0.6	Adc
Peak af Grid Voltage 2	275	v
Peak Driving Power	0	w
Max. Signal Plate Dissipation 2	41.7	kW
Plate Output Power	195	kW
Load Resistance (plate to plate)	1870	Ω

1. Approximate value.
2. Per tube.
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Filament: Current at 12.0 volts	200	230	A
Interelectrode Capacitances (grounded cathode connection)			
Input	290	330	pF
Output	45	58	pF
Feedback	---	1.0	pF
Interelectrode Capacitances (grounded grid connection)			
Input	130	150	pF
Output	47	57	pF
Feedback	---	0.5	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CW50,000E must be operated with its axis vertical. The base of the tube may be up or down at the convenience of the circuit designer.

SOCKET - The EIMAC socket type SK-2000 is recommended for use with the 4CW50,000E.

COOLING - Anode cooling is accomplished by circulating water through the SK-2050 water jacket. The table below lists minimum cooling water requirements at various dissipation levels.

Plate Dissipation* (kilowatts)	Water Flow (GPM)	Pressure Drop (PSI)
10	3.0	2.0
20	5.0	3.0
30	6.5	4.0
40	8.5	5.2
50	10.5	6.5

*Since the power dissipated by the filament represents about 2500 watts and since grid-plus-screen dissipation can, under some conditions, represent another 1900 watts, allowance has been made in preparing this tabulation for an additional 4400 watts dissipation.

The cooling table above assumes a water temperature rise of 20°C. Under no circumstances should the outlet water temperature exceed 70°C. Inlet water pressure should not exceed 100 psi.

A major factor affecting long life of water cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 K ohms/cm^3, and preferably above 250 K ohms/cm^3. A relative water resistance check can be made continuously by measuring the leakage current which will bypass a short section of the insulating hose column if metal nipples or fittings are used as electrodes.

Separate cooling of the tube base is required and is accomplished by directing approximately 200 cfm of air through the socket.

ELECTRICAL

FILAMENT OPERATION - Filament voltage should be measured at the socket with a 1 percent rms responding meter. The peak emission at rated filament voltage of the EIMAC 4CW50,000E is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CW50,000E by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not adversely affect equipment operation. This is

done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CW50,000E. At some point in filament voltage there will be noticeable reduction in plate current, or power output, or an increase in distortion. Operation must be at a filament voltage slightly higher than the point at which performance appears to deteriorate. This point should be periodically checked to maintain proper operation.

GRID OPERATION - The 4CW50,000E control grid is rated at 400 watts of dissipation. Grid dissipation is the approximate product of grid current and peak positive grid voltage.

SCREEN DISSIPATION - The power dissipated by the screen grid must not exceed 1500 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is dependent on rms screen voltage, and rms screen current. Plate voltage, plate load or bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

The 4CW50,000E may exhibit reversed screen current to a greater or lesser degree depending on operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished with a bleeder resistor connected from screen to cathode, or an electron-tube regulator circuit may be employed in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed.

PLATE DISSIPATION - The plate dissipation of 50 kilowatts attainable through water cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CW50,000E is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 33,300 watts.

STANDBY OPERATION - Coolant must be circulated through the anode water jacket whenever filament power is applied even though no other voltages are present. Sixty to eighty percent of the filament power appears as heat in the anode. In the absence of coolant, flow temperatures will rise to levels which are detrimental to long life. If the coolant lines are obstructed the coolant jacket may rupture from the generated steam pressure.

HIGH VOLTAGE - Normal operating voltages used with the 4CW50,000E are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CW50,000E, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

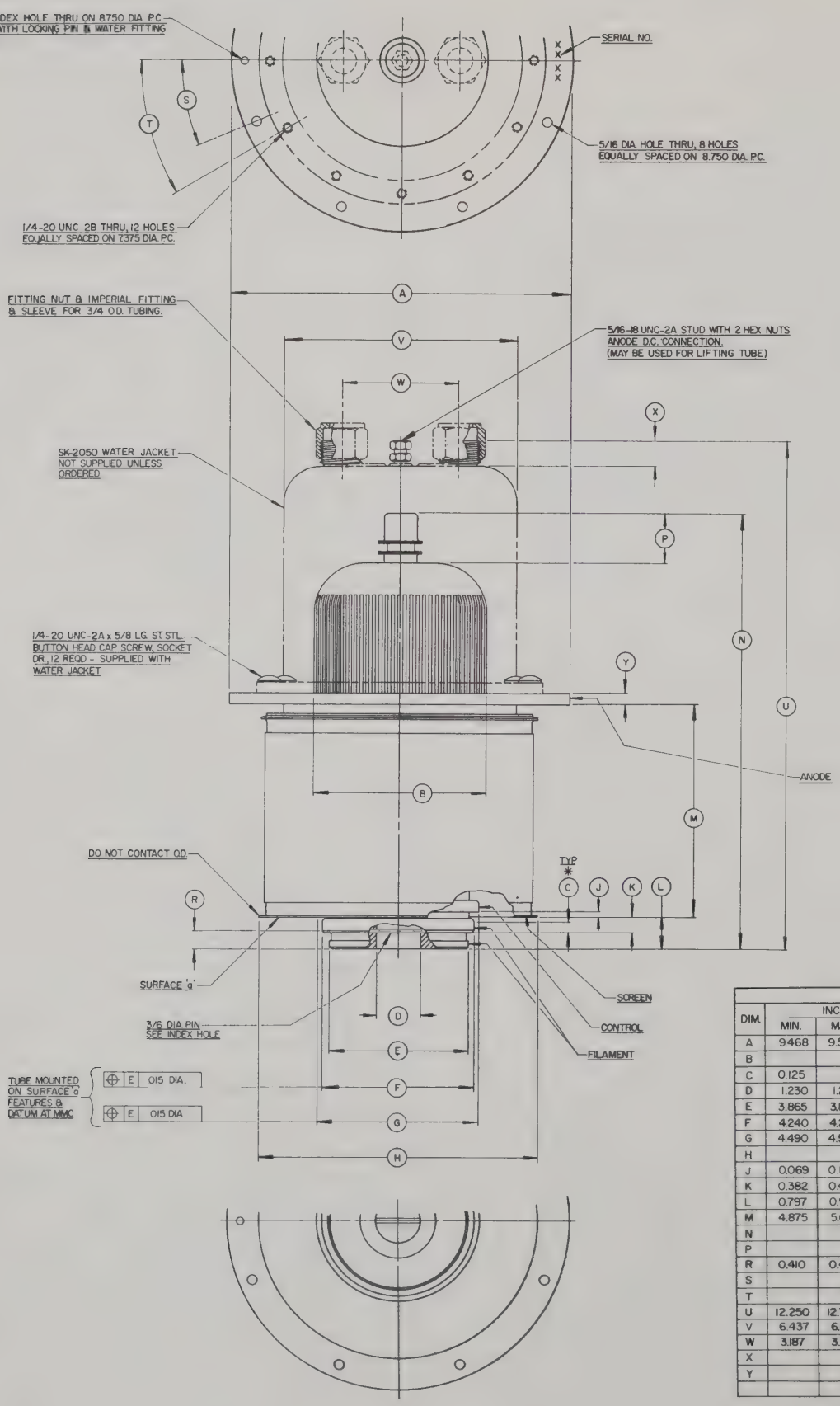
RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 4CW-50,000E, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

FAULT PROTECTION - In addition to normal plate over-current interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

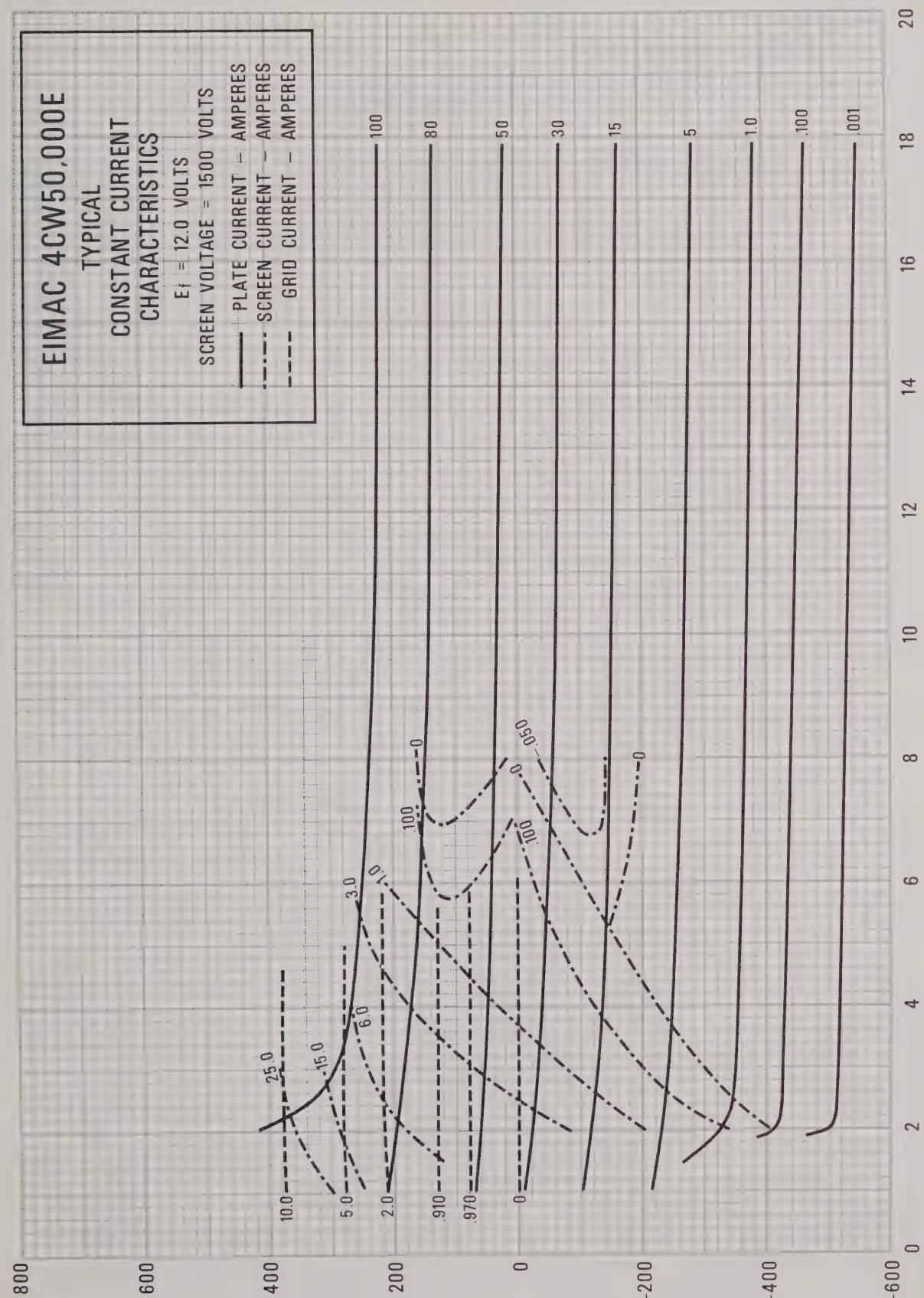
SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.



DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF	MIN.	MAX.	REF
A	9.468	9.531		240.49	242.09	
B			5.000			127.00
C	0.125			3.18		
D	1.230	1.270		31.24	32.26	
E	3.865	3.885		98.17	98.68	
F	4.240	4.260		107.70	108.20	
G	4.490	4.510		114.05	114.55	
H			7.750			196.85
J	0.069	0.149		1.75	3.78	
K	0.382	0.462		9.70	11.73	
L	0.797	0.922		20.24	23.42	
M	4.875	5.000		123.83	127.00	
N			11.500			292.10
P			1.437			36.50
R	0.410	0.475		10.41	12.07	
S			22.5°			22.5°
T			30°			30°
U	12.250	12.750		311.15	323.85	
V	6.437	6.562		163.50	166.67	
W	3.187	3.313		80.95	84.15	
X			0.562			14.27
Y			0.312			7.92

DIMENSIONAL DATA

NOTES:
1. REF DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

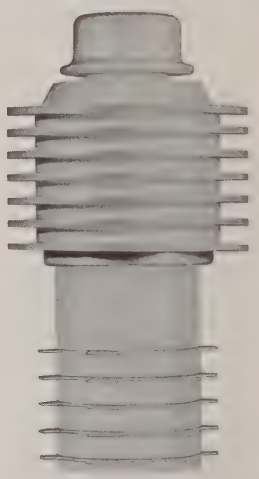

EIMAC 4CW50,000E
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
Ef = 12.0 VOLTS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
100
80
50
30
15
5
1.0
.100
.001
25.0
15.0
10.0
6.0
5.0
3.0
2.0
.910
.970
0
.050
.100
800
600
400
200
0
-200
-400
-600
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)

CURVE #3993

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

4CX125C
4CX125F

RADIAL-BEAM POWER TETRODES



The Eimac 4CX125C and 4CX125F are horizontally-finned versions of the 4CX300A. These tubes possess the same rugged internal features of the 4CX300A and are quite free of mechanical noise under severe shock and vibration conditions.

The horizontal fins used on these tubes result in a lighter and smaller tube than the 4CX300A. Transverse cooling air-flow is required to attain the 125 watt nominal plate dissipation rating.

GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-coated, Unipotential				
	Heating Time	30	60		seconds
	Cathode-to-heater Potential			± 150	volts
Heater:	Voltage: 4CX125C		6.0		volts
	4CX125F		26.5		volts
	Current: 4CX125C	2.6		3.1	amperes
	4CX125F	0.6		0.7	amperes
Amplification Factor (Grid-Screen)		4.0		5.6	
Transconductance (I_b = 200 Ma)			12,000		umhos
Frequency for Maximum Ratings				500	Mc

Interelectrode Capacitances, Grounded Cathode:	Min.	Max.	
Input	25.0	33.0	uuf
Output	3.5	4.5	uuf
Feedback		0.06	uuf

MECHANICAL

Base	Special, breechblock terminal surfaces
Socket	Eimac SK-700 series
Maximum Operating Temperatures:	
Anode Core	250° C
Ceramic-to-Metal-Seals	250° C
Operating Position	Any
Cooling	Forced air
Net Weight	3.5 ounces
Shipping Weight (Approximate)	1 pound

MAXIMUM RATINGS

	Class-C Plate Mod	Class-C Teleg or FM	Class-AB Audio or SSB	
DC PLATE VOLTAGE	1500	2000	2000	MAX. VOLTS
DC SCREEN VOLTAGE	300	300	400	MAX. VOLTS
DC GRID VOLTAGE	-250	-250	---	MAX. VOLTS
DC PLATE CURRENT	200	250	250	MAX. MA
PLATE DISSIPATION	83	125	125	MAX. WATTS
SCREEN DISSIPATION	12	12	12	MAX. WATTS
GRID DISSIPATION	2	2	2	MAX. WATTS

Note: See data sheet for 4CX300A for characteristic curves and typical operating conditions.

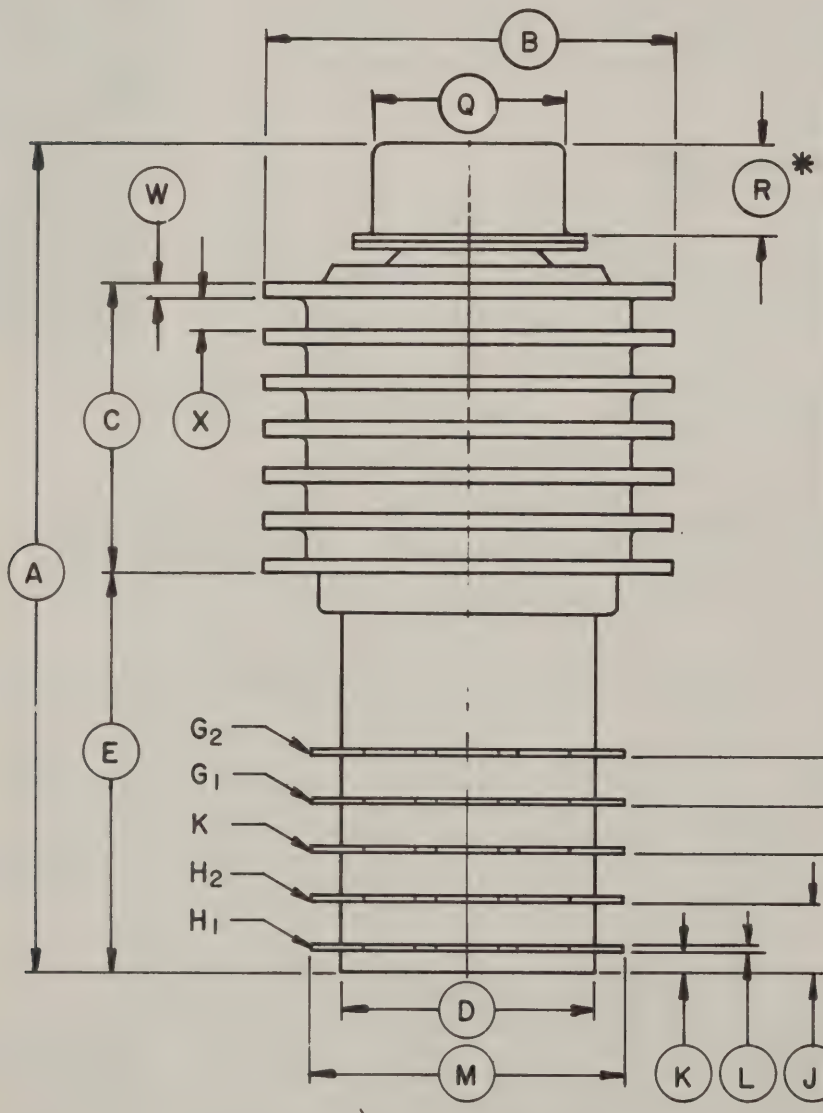
TYPICAL OPERATION

RF Amplifier (excluding circuit losses)	DC Plate Voltage (Volts)	Driving Power (Watts)	Input Power (Watts)	Output Power (Watts)
Class-C Telegraphy or FM Telephony	2000	3.0	500	390
Plate-Modulated Telephony (Carrier)	1500	2.0	300	235
Class-AB_1 Linear Amplifier	2000	0	315	205

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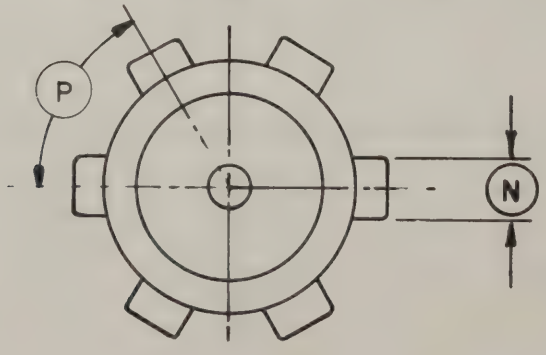
APPLICATION

Cooling: The 4CX125C and 4CX125F are intended for use where transverse cooling air is desired. With the anode cooler installed in a duct of 1" x 1-1/2" cross section, approximately 8 cfm of air is required to maintain seal temperatures below 250° C. This presumes sea level operation with an ambient temperature of 25° C or less. Sufficient air must also be circulated around the base terminals to maintain the rated seal temperatures.



DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	2.300	2.500	
B	1.240DIA	1.265DIA.	
C	.710	.790	
D	.740DIA	.770DIA	
E	1.133	1.195	
F	.602	.642	
G	.470	.500	
H	.329	.359	
J	.193	.213	
K	.050	.072	
L	.010	.020	
M	.936DIA.	.956DIA.	
N	.170	.185	
P			60°
Q	.559DIA.	.573DIA.	
R	.240	.280	
W			.040
X	.060	.090	



NOTE: These dimensions reflect standard manufacturing tolerances. Where they are to be made the basis of purchase specifications, they should first be checked with the factory.

NOTES:

1. DIMENSIONS IN INCHES.
2. (*) CONTACT SURFACE

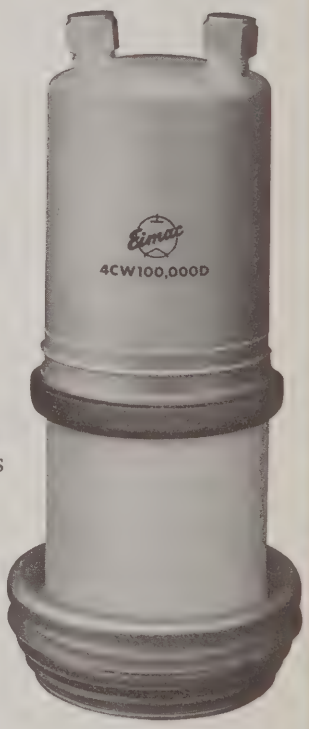
EIMAC
Division of Varian
SAN CARLOS

4CW100,000D

LIQUID COOLED POWER TETRODE

The EIMAC 4CW100,000D is a ceramic-metal, liquid-cooled power tetrode intended for use at the 100 to 200 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB, rf linear amplifier or a Class-AB, push-pull af amplifier or modulator. The 4CW100,000D is also useful as a plate and screen modulated Class-C rf amplifier, and in pulse modulator-regulator service.

The liquid-cooled anode is rated at 100 kilowatts maximum plate dissipation.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	*Nom.*	*Max.*	
Filament: Thoriated Tungsten				
Voltage		10		Volts
Current	280		310	Amps
Amplification Factor (Grid-Screen) (average)		4.5		
Interelectrode Capacitances, Grounded Cathode:				
Input	410		470	pF
Output	50		60	pF
Feedback	1.5		3.2	pF
Interelectrode Capacitances, Grounded Grid:				
Input	155		195	pF
Output	52		62	pF
Feedback			0.60	pF
Frequency for Maximum Ratings			30	MHz

MECHANICAL

Base	Special, graduated rings
Maximum Seal Temperature	250°C
Maximum Anode-Core Temperature	250°C
Recommended Socket	EIMAC SK-1500 Series
Operating Position	Vertical, base up or down
Maximum Dimensions:	
Height	18.0 inches
Diameter	8.0 inches
Cooling	Liquid and forced air
Net Weight	60 pounds
Shipping Weight (approximate)	85 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 VOLTS
DC SCREEN VOLTAGE	2500 VOLTS
DC PLATE CURRENT	15.0 AMPS
PLATE DISSIPATION	100,000 WATTS
SCREEN DISSIPATION	1750 WATTS
GRID DISSIPATION	500 WATTS

*Calculated low frequency drive power

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	15.0	17.0	19.0 kV
DC Screen Voltage	750	750	750 volts
DC Grid Voltage	–700	–700	–700 volts
DC Plate Current	9.0	9.8	10.6 amps
DC Screen Current	1.6	1.67	1.83 amps
DC Grid Current	0.8	1.0	1.12 amps
Peak RF Grid Voltage	1000	1020	1040 volts
Driving Power*	790	1020	1165 watts
Plate Dissipation	24.0	30.0	35 kW
Plate Output Power	110	137.5	165 kW
Resonant Load Impedance	825	845	980 ohms

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Printed in U.S.A.

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class-C Telephony
(Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	17,500 VOLTS
DC SCREEN VOLTAGE	2000 VOLTS
DC PLATE CURRENT	15.0 AMPS
PLATE DISSIPATION*	66,500 WATTS
SCREEN DISSIPATION‡	1750 WATTS
GRID DISSIPATION‡	500 WATTS

*Corresponds to 100,000 watts at 100 percent sine wave modulation
**Approximate value, depends on degree of driver modulation
†Calculated low frequency drive power
‡Average, with or without modulation

TYPICAL OPERATION (Frequencies below 30 MHz)

DC Plate Voltage	14	16	kV
DC Screen Voltage	750	750	volts
Peak AF Screen Voltage (For 100% modulation)**	750	750	volts
DC Grid Voltage	–700	–740	volts
DC Plate Current	9.1	10.0	amps
DC Screen Current	2.0	1.48	amps
DC Grid Current	1.0	0.82	amps
Peak RF Grid Voltage	1000	1060	volts
Grid Driving Power†	1000	870	watts
Plate Dissipation	20.4	21.5	kW
Plate Output Power	107	138.5	kW
Resonant Load Impedance	790	810	ohms

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	20,000 VOLTS
DC SCREEN VOLTAGE	2500 VOLTS
DC PLATE CURRENT	15.0 AMPS
PLATE DISSIPATION	100,000 WATTS
SCREEN DISSIPATION	1750 WATTS
GRID DISSIPATION	500 WATTS

*Per Tube
**Approximate value

TYPICAL OPERATION (Two Tubes) Class-AB_1

DC Plate Voltage	15	18	kV
DC Screen Voltage	1.5	1.5	kV
DC Grid Voltage	–360	–380	volts
Max-Signal Plate Current	18.8	20.0	amps
Zero-Signal Plate Current	6.0	6.0	amps
Max-Signal Screen Current**	0.690	0.700	amps
Peak AF Driving Voltage*	350	380	volts
Driving Power	0	0	watts
Load Resistance, Plate-to-Plate	1800	2080	ohms
Max-Signal Plate Dissipation*	47.3	56.8	kW
Max-Signal Plate Output Power	187.4	246.4	kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 VOLTS
DC SCREEN VOLTAGE	2500 VOLTS
DC PLATE CURRENT	15.0 AMPS
PLATE DISSIPATION	100,000 WATTS
SCREEN DISSIPATION	1750 WATTS
GRID DISSIPATION	500 WATTS

*Approximate value

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions, (Frequencies below 30 MHz) Class-AB_1

DC Plate Voltage	15	18	kV
DC Screen Voltage	1.5	1.5	kV
DC Grid Voltage	–360	–380	volts
Max-Signal Plate Current	9.4	10.0	amps
Zero-Signal Plate Current	3.0	3.0	amps
Max-Signal Screen Current*	0.345	0.350	amps
Peak RF Grid Voltage	350	380	volts
Driving Power	0	0	watts
Plate Dissipation	47.3	56.8	kW
Plate Output Power	93.7	123.2	kW
Resonant Load Impedance	900	1040	ohms

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

DC PLATE VOLTAGE	40 kV
DC SCREEN VOLTAGE	2.5 kV
DC GRID VOLTAGE	2.0 kV
PEAK CATHODE CURRENT	200 AMPS
PLATE DISSIPATION (Average)	100 kW
SCREEN DISSIPATION (Average)	1750 WATTS
GRID DISSIPATION (Average)	500 WATTS

*Approximate value
Note: The power dissipated during rise and fall time is considered negligible

TYPICAL OPERATION

DC Plate Voltage	38 kV
Pulse Plate Current	112 amps
DC Screen Voltage	1.5 kV
Pulse Screen Current*	18.0 amps
DC Grid Voltage	–1.2 kV
Pulse Grid Current*	10.0 amps
Pulse Positive Grid Voltage	480 volts
Duty	5 %
Pulse Output Voltage	32 kV
Pulse Input Power	16.4 kW
Pulse Output Power	360 MW
Pulse Cathode Current	140 amps

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when the tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied. Driving power is calculated for frequencies below those where grid circuit loading is a factor.

APPLICATION

MECHANICAL

Mounting — The 4CW100,000D must be operated with its axis vertical. The base of the tube may be up or down at the convenience of the circuit designer.

Socket — The EIMAC sockets, type SK-1500 and SK-1510 are recommended for use with the 4CW100,000D.

Cooling — Anode cooling is accomplished by circulating water through the integral anode water jacket. The table below lists minimum cooling water requirements at various dissipation levels.

Plate Dissipation* (kilowatts)	Water Flow (GPM)	Pressure Drop (PSI)
20	5.0	4.0
40	8.0	7.0
60	12.0	14.0
80	16.0	22.0
100	20.0	30.0

*Since the power dissipated by the filament represents about 3000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 2250 watts, allowance has been made in preparing this tabulation for an additional 5250 watts dissipation.

The cooling table above assumes a water temperature rise of 20°C. Under no circumstances should the outlet water temperature exceed 70°C. Inlet water pressure should not exceed 80 PSI.

A major factor effecting long life of water cooled tubes is the condition of the cooling water. If the cooling water is ionized, deposits of copper oxide will form on the internal parts of the water jacket and can cause localized heating of the anode and eventual failure of the tube.

A simple method of determining the condition of the water is to measure the resistance across a known volume. The resistance of the water should be maintained above 50 K ohms/cm^3, and preferably above 250 K ohms/cm^3. A relative water resistance check can be made continuously by measuring the leakage current which will bypass a short section of the insulating hose column if metal nipples or fittings are used as electrodes.

Separate cooling of the tube base is required and is accomplished by directing approximately 120 cfm of air horizontally through the socket from the side. It is preferable to direct this air through three equally spaced ducts.

The well in the center of the baseplate of the tube is a critical area which requires cooling to maintain envelope temperatures less than 250°C. For most applications, 1 to 2 cfm of air directed through the center of the socket is sufficient for this purpose.

ELECTRICAL

Filament Operation — The peak emission at rated filament voltage of the EIMAC 4CW100,000D is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CW100,000D by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CW100,000D. At some point in filament voltage there will be noticeable reduction in plate current, or power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appeared to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked to maintain proper operation.

Filament starting current must be limited to a maximum of 900 amperes.

Voltage between filament and the base plates of either tube, or SK-1500 socket, must not exceed 100 volts.

Control-Grid Operation—The 4CW100,000D control grid is rated at 500 watts of dissipation. Grid dissipation is the approximate product of grid current and peak positive grid voltage.

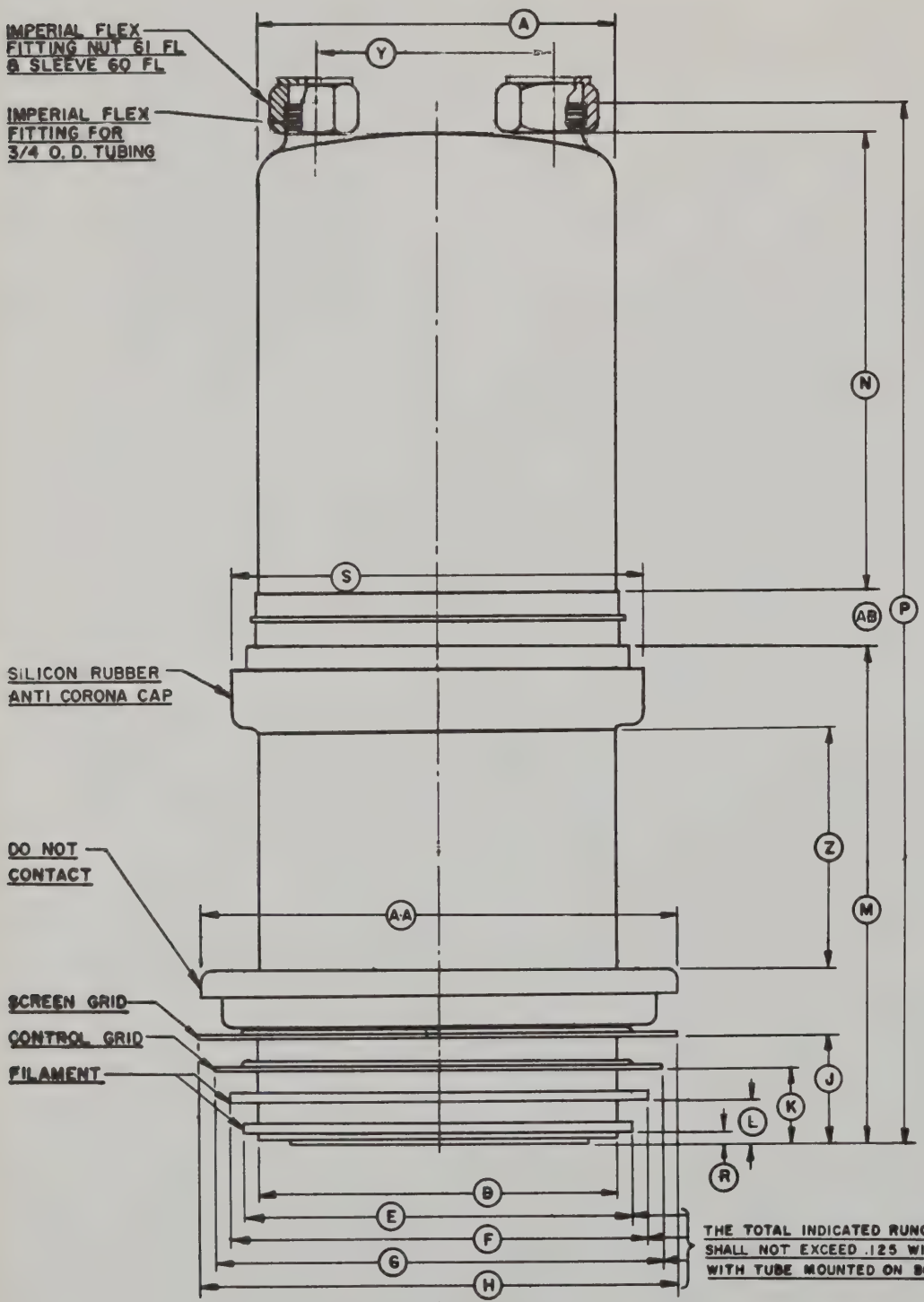
Screen Dissipation — The power dissipated by the screen grid must not exceed 1750 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is dependent on RMS screen voltage, and RMS screen current. Plate voltage, plate load or bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to prevent any of these conditions.

Plate Dissipation — The plate dissipation of 100 kilowatts attainable through water cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CW100,000D is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 66,500 watts.

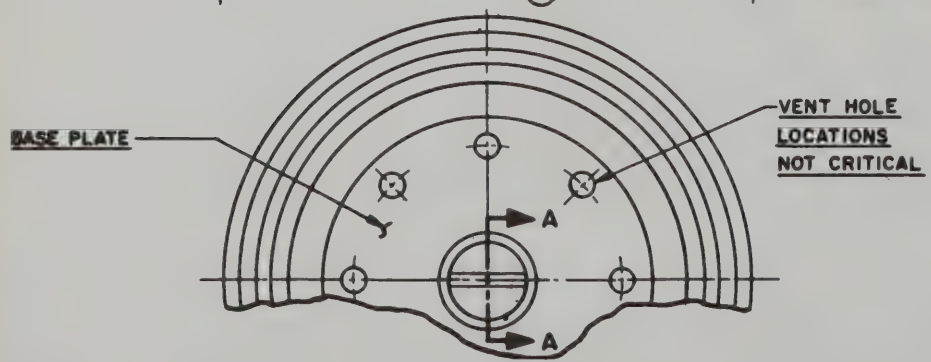
Fault Protection — In addition to normal plate overcurrent interlock, screen current interlock, and coolant flow interlock, it is good practice to protect the tube from internal damage which could result from occasional plate arcing at high anode voltage.

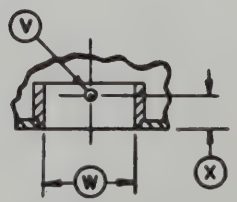
In all cases some protective resistance, 5 ohms to 25 ohms, should be used in series with each tube anode to absorb power supply stored energy in case a plate arc should occur. If power supply stored energy exceeds 750 watt seconds, we strongly recommend use of some form of electronic crowbar which will discharge power supply capacitors in a few microseconds following indication of start of a plate arc.

Special Application — Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.



THE TOTAL INDICATED RUNOUT OF THESE CONTACT EDGES SHALL NOT EXCEED .125 WITH RESPECT TO "W" MEASURED WITH TUBE MOUNTED ON BOTTOM CERAMIC



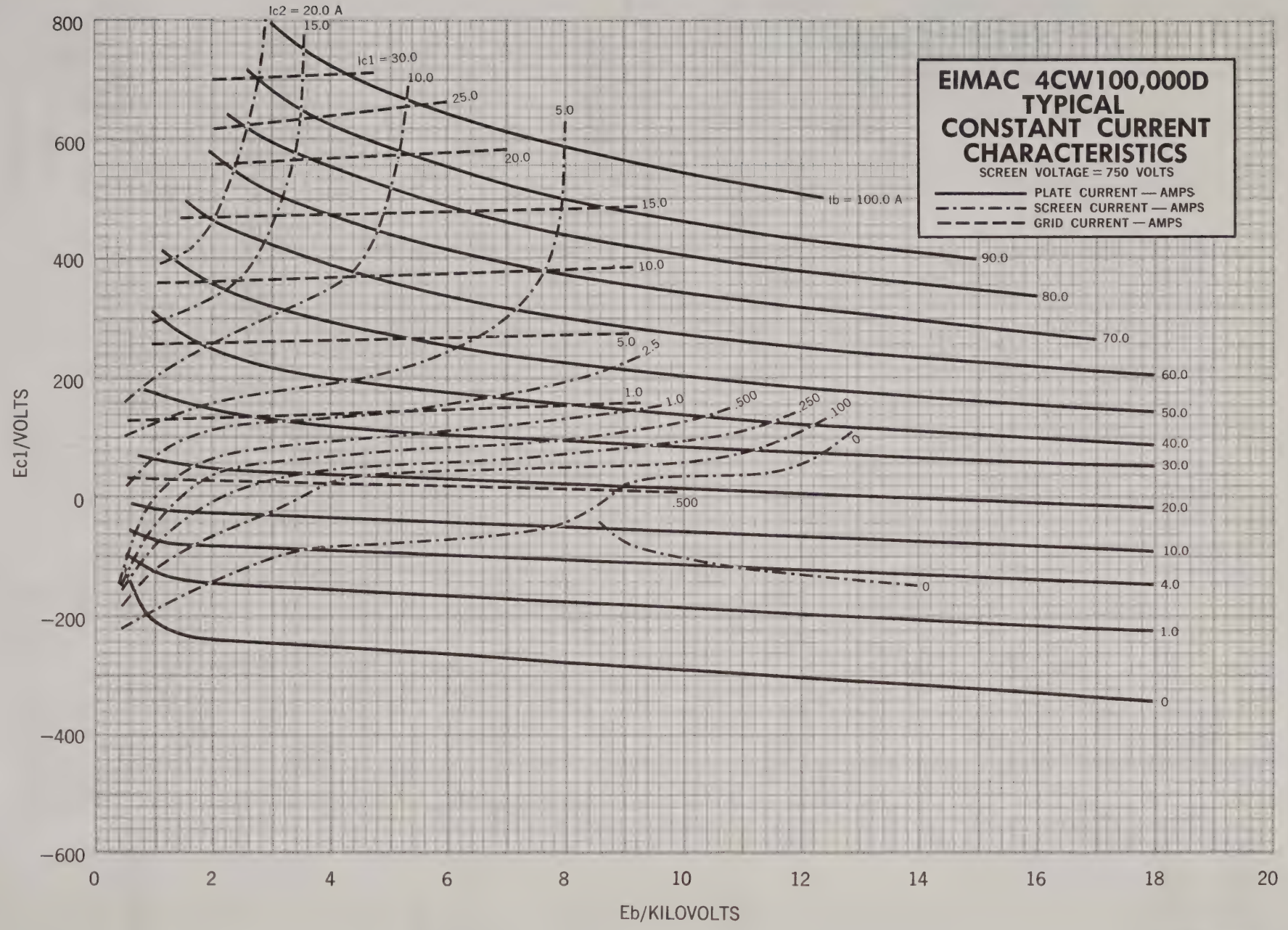


SECTION A-A
ROTATED 180°

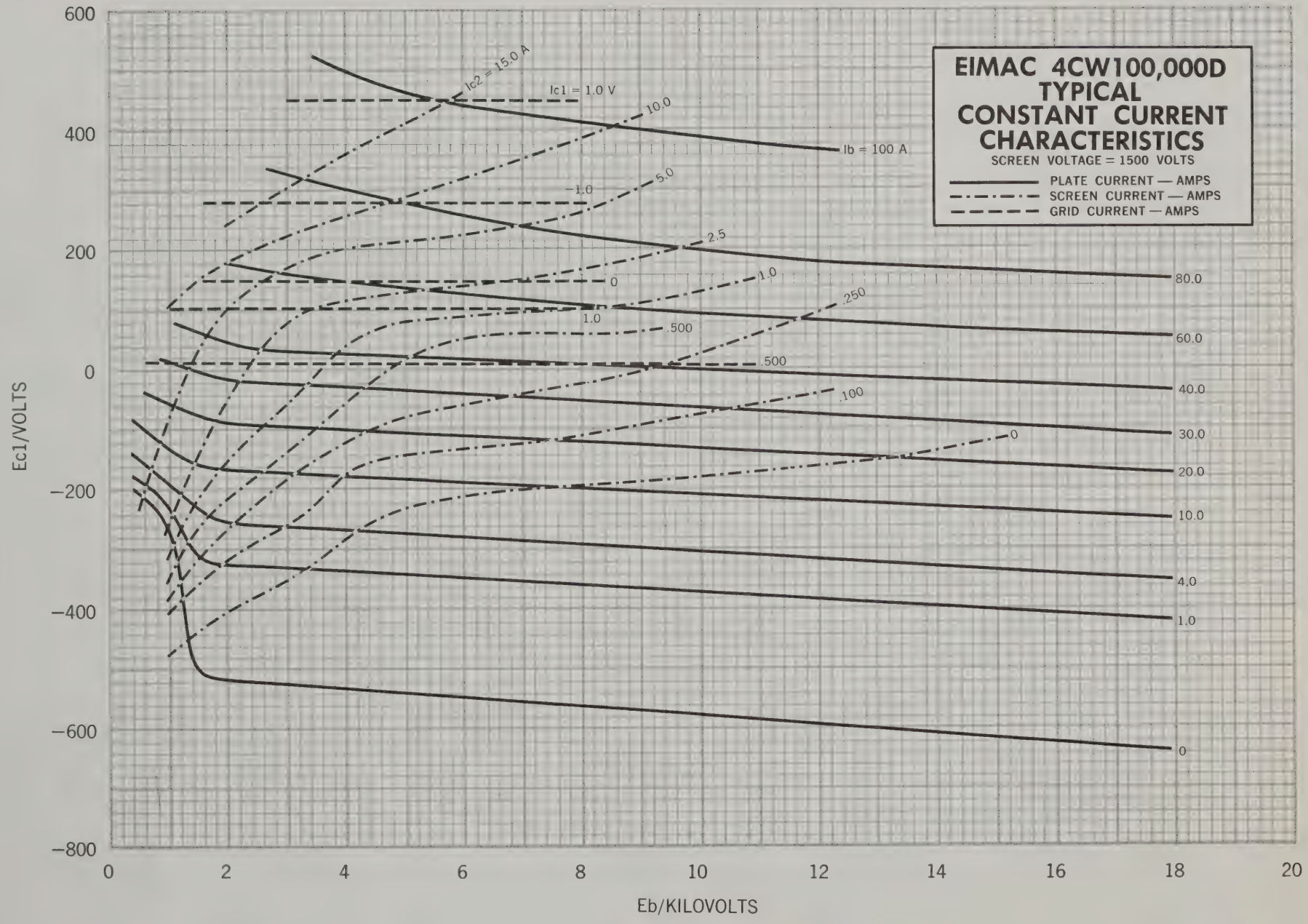
DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	5.875	6.125	
D	5.980	6.020	
E	6.510	6.560	
F	6.980	7.020	
G	7.480	7.520	
H	7.975	8.015	
J	1.750	1.800	
K	1.220	1.270	
L	.690	.740	
M	8.600	8.800	
N	7.000	7.500	
P	17.250	18.000	
R	.173	.213	
S			6.950
V		.135	
W	1.250	1.270	
X	.490	.530	
Y	3.940	4.060	
Z			4.200
AA			8.000
AB			1.080

NOTES:
1. THE LATERAL AXES OF THE WATER FITTINGS & BASE LOCKING PIN ARE TO BE WITHIN 10°
2. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.


EIMAC 4CW100,000D
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ic2 = 20.0 A
15.0
Ic1 = 30.0
10.0
25.0
5.0
20.0
15.0
10.0
5.0
2.5
1.0
1.0
.500
.250
.100
0
.500
0
Ib = 100.0 A
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
4.0
1.0
0
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
12
14
16
18
20
Ec1/VOLTS
Eb/KILOVOLTS

CURVE #2623


EIMAC 4CW100,000D
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ic2 = 15.0 A
Ic1 = 1.0 V
Ib = 100 A
10.0
5.0
2.5
1.0
.500
.250
.100
0
80.0
60.0
40.0
30.0
20.0
10.0
4.0
1.0
0
600
400
200
0
−200
−400
−600
−800
Ec1/VOLTS
0
2
4
6
8
10
12
14
16
18
20
Eb/KILOVOLTS

CURVE #2621

TECHNICAL DATA

4CW100,000E

HIGH-POWER
WATER-COOLED
TETRODE

DESCRIPTION

The 4CW100,000E is a ceramic/metal, high-power tetrode for applications requiring tube outputs from 100 to 250 kilowatts. It is ideal for use as a Class C rf amplifier or oscillator, a Class AB rf linear amplifier, or a Class AB push-pull af amplifier or modulator as well as a plate- and screen-modulated Class C rf amplifier. In pulse-modulator service, it can deliver a peak output of 4 megawatts. The tube is characterized by low input and feedback capacitances and low internal lead inductances. Its rugged mesh thoriated-tungsten filament provides ample emission for long operating life. The water-cooled anode dissipates 100 kilowatts when used with the EIMAC SK-2100 water jacket.



4CW100,000E without SK-2100 Water Jacket

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament	Thoriated Tungsten
Voltage	15.5 ± 0.75 V
Current, at 15.5 V	215 A
Direct Interelectrode Capacitances,	
Cathode grounded	
Input	370 pF
Output	60 pF
Feedback	1.0 pF
Grid grounded	
Input	175 pF
Output	60 pF
Feedback	0.35 pF
Maximum Frequency, for maximum CW ratings	108 MHz

PHYSICAL

Dimensions	See Outline Drawing
Net Weight	
Tube only	38.5 lb; 17.5 kg
Tube and water jacket	47.0 lb; 21.4 kg
Operating Position	Vertical, base up or down
Anode Cooling	Water
Base Cooling	Forced Air
Operating Temperature, maximum	
Ceramic/metal seals and envelope	250 °C
Anode Water Jacket, required	EIMAC SK-2100
Air System Socket, recommended	EIMAC SK-2000 Series
Base	Special

MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

RADIO FREQUENCY LINEAR AMPLIFIER, Class AB

Absolute Maximum Ratings

Plate Voltage	20 kVdc
Screen Voltage	2.5 kVdc
Plate Current	16 Adc
Plate Dissipation	100 kW
Screen Dissipation	1750 W
Grid Dissipation	500 W

Typical Operation, Class AB_1, Grid Driven

Peak Envelope or Modulation Crest Conditions

Plate Voltage	18 kVdc
Screen Voltage	1.5 kVdc
Grid Voltage[2]	-320 Vdc
Zero-Signal Plate Current	4 Adc
Single-Tone Plate Current	13.5 Adc
Peak rf Grid Voltage, approx	300 v
Plate Dissipation	75 kW
Plate Output Power	168 kW
Resonant Load Impedance	697 Ω

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MAXIMUM RATINGS AND TYPICAL OPERATING CONDITIONS

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR
Class C Telegraphy or FM Telephony
(Key-down Conditions)

Absolute Maximum Ratings

Plate Voltage	20 kVdc
Screen Voltage	2.5 kVdc
Plate Current	16 Adc
Plate Dissipation	100 kW
Screen Dissipation	1750 W
Grid Dissipation	500 W

Typical Operation

Plate Voltage	20 kVdc
Screen Voltage	1.5 kVdc
Grid Voltage	-800 Vdc
Plate Current	15.2 Adc
Screen Current, approx	567 mAdc
Grid Current, approx	125 mAdc
Peak rf Grid Voltage, approx	900 v
Driving Power, calculated, approx	120 W
Plate Dissipation	54 kW
Plate Output Power	220 kW
Resonant Load Impedance	575 Ω

PLATE MODULATED RADIO FREQUENCY AMPLIFIER
GRID DRIVEN - Class C Telephony
(Carrier Conditions)

Absolute Maximum Ratings

Plate Voltage	17.5 kVdc
Screen Voltage	2.0 kVdc
Plate Current	16 Adc
Plate Dissipation[3]	67 kW
Screen Dissipation[4]	1750 W
Grid Dissipation[4]	500 W

Typical Operation

Plate Voltage	15 kVdc
Screen Voltage	750 Vdc
Grid Voltage	-600 Vdc
Plate Current	11.7 Adc
Screen Current, approx	875 mAdc
Grid Current, approx	660 mAdc
Peak af Screen Voltage, 100% mod., approx	750 v
Peak rf Grid Voltage, approx	800 v
Driving Power, calculated	530 W
Plate Dissipation	35 kW
Plate Output Power	140 kW
Resonant Load Impedance	620 Ω

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
GRID DRIVEN - Class AB_1, Sinusoidal Wave

Absolute Maximum Ratings, per tube

Plate Voltage	20 kVdc
Screen Voltage	2.5 kVdc
Plate Current	16 Adc
Plate Dissipation	100 kW
Screen Dissipation	1750 W
Grid Dissipation	500 W

Typical Operation, two tubes

Plate Voltage	15 kVdc
Screen Voltage	1.5 kVdc
Grid Voltage, approx[2]	-345 Vdc
Zero-Signal Plate Current	6 Adc
Maximum-Signal Plate Current	19.5 Adc
Maximum-Signal Screen Current, approx	830 mAdc
Peak af Grid Voltage, per tube	275 v
Maximum-Signal Plate Dissipation, per tube	46 kW
Plate Output Power	200 kW
Load Resistance, plate to plate	1825 Ω

PULSE MODULATOR SERVICE

Absolute Maximum Ratings

Plate Voltage	40 kVdc
Screen Voltage	2.5 kVdc
Grid Voltage	-2.0 kVdc
Peak Cathode Current	200 a
Plate Dissipation, during the pulse[5]	1.0 MW
Plate Dissipation, average	100 kW
Screen Dissipation, average	1750 W
Grid Dissipation, average	500 W
Pulse Length	10 ms

Typical Operation

Plate Voltage	40 kVdc
Plate Current, pulse	110 a
Screen Voltage	2.5 kVdc
Screen Current, pulse, approx	12 a
Grid Voltage	-1.2 kVdc
Grid Current, pulse, approx	400 ma
Positive Grid Voltage, pulse	110 v
Duty	6 %
Output Voltage, pulse	37 kv
Input Power, pulse	4.4 Mw
Output Power, pulse	4.1 Mw
Cathode Current, pulse, approx	122 a

TYPICAL OPERATION values are obtained by calculations from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min	Max
Filament Current, at 15.5 V ...	200	230 A
Cutoff Bias, at Eb = 25 kVdc, Ec2 = 1500 Vdc, Ib = 10 mAdc	---	-650 Vdc
Interelectrode Capacitances,		
Cathode grounded		
Input	350	390 pF
Output	55	65 pF
Feedback	---	1.2 pF
Grid grounded		
Input	160	190 pF
Output	55	65 pF
Feedback	---	0.5 pF

NOTES:

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. The EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Adjust to give specified zero-signal plate current.
3. Corresponds to 100 kW at 100% sine-wave modulation.
4. Average value, with or without modulation.
5. Power dissipated during rise and fall time neglected.

APPLICATION NOTES

MOUNTING — The 4CW100,000E must be mounted with its major axis vertical. The tube base may be either up or down, at the discretion of the circuit designer.

SOCKETING — An EIMAC SK-2000 series Socket, or equivalent, is recommended.

ANODE WATER JACKET — The EIMAC SK-2100 Water Jacket must be used to provide anode cooling. To achieve an anode dissipation of 100 kilowatts, the water jacket must be installed over the tube anode and adequate water flow provided.

COOLING — Anode cooling is accomplished by circulating water through the SK-2100 Water Jacket. Insufficient water flow will cause the anode temperature to rise to levels which will shorten tube life. Also, if the coolant lines become clogged, enough steam pressure may be generated to rupture the water jacket and destroy the tube. The following table lists the minimum cooling water requirements at various dissipation levels with a maximum inlet water temperature of 50 °C.

Anode Dissipation (kW)	Minimum Water Flow (gpm)	Approximate Pressure Drop (psi)
20	5.0	2.8
40	9.0	5.8
60	12.5	9.3
80	16.5	14.2
100	20.0	19.2

Note: Since the filament dissipates about 3500 watts, and the grid-plus-screen can, under some conditions, dissipate another 2250 watts, the table allows for an additional dissipation of 5750 watts.

Outlet water temperature must never exceed 70 °C and inlet water pressure should be limited to 100 psi. Direction of water flow is optional.

Tube life can be seriously affected by the condition of the cooling water. If it becomes ionized, copper-oxide deposits form on the inside of the water jacket causing localized anode heating and eventual tube failure.

To insure minimum electrolysis, and power loss, the water resistance at 20 °C should be greater than 50,000 ohms/cm^3, preferably 250,000 ohms/cm^3 or higher. The relative water resistance can be continuously monitored by measuring the leakage current through a short section of the insulating hose, using metal nipples or fittings as electrodes.

Auxiliary forced-air cooling, of the tube base is required to maintain filament- and grid-seal temperatures below 250 °C. An air flow of approximately 120 ft^3/min at 50 °C maximum and sea level should be directed, through an EIMAC SK-2000 series socket or equivalent, toward the filament- and grid-seal areas.

Both anode and base cooling should be applied before or simultaneously with the application of electrode voltages, including the filament. Base cooling should continue for about three minutes after the removal of electrode voltages to allow the tube to cool properly.

FILAMENT OPERATION — At rated filament voltage, the peak emission of a 4CW100,000E is many times greater than the amount needed for communication service. Reducing the filament voltage decreases the filament temperature. A small decrease in filament temperature substantially increases filament life. The correct value of filament-voltage should be determined for the particular applications. First, gradually reduce the filament voltage to the point where there is a noticeable reduction in plate current or power output, or an increase in distortion. Then increase the voltage several tenths of a volt above the value where performance degradation occurred; this is the proper operating voltage. Filament voltage should always be measured at the tube base or socket using an rms responding meter. The above procedure should be performed periodically to assure optimum tube life.

GRID OPERATION — The maximum control-grid dissipation is 500 watts, determined approximately by the product of grid current and peak positive grid voltage.

Under some operating conditions, the control grid may exhibit a negative-resistance characteristic. This may occur when, with high screen-grid voltage, increasing the drive voltage decreases the grid current. As a result, large values of instantaneous negative grid current can be produced, causing the amplifier to become regenerative. Because this may happen, the driver stage must be designed to tolerate this condition. One technique is to swamp the driver so that the change in load, due to secondary grid emission, is a small percentage of the total driver load.

SCREEN OPERATION — The maximum screen-grid dissipation is 1750 watts. With no ac applied to the screen, dissipation is simply the product of dc screen voltage and dc screen current. With screen modulation, dissipation is dependent on rms screen voltage and rms screen current. Plate voltage, plate loading, or bias voltage must never be removed while filament and screen voltages are present, since the screen dissipation rating will be exceeded. Suitable protective circuitry should be provided.

The 4CW100,000E may exhibit reverse screen current to a greater or lesser degree depending on operating conditions. The screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished with a bleeder resistor connected from screen to cathode, or an electron-tube regulator circuit may be employed in the screen supply. A bleeder resistor must be used if a series electron-tube regulator is employed.

PLATE DISSIPATION — The rated plate dissipation of 100 kilowatts, attainable with water cooling, provides a large margin of safety in most applications. This rating may be exceeded briefly during tuning. When the 4CW100,000E is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions should be limited to 67 kilowatts.

FAULT PROTECTION — In addition to the normal plate-overcurrent interlock, screen-current interlock, and coolant-flow interlock, it is good practice to protect the tube from internal damage caused by an internal plate arc which may occur at high plate voltages.

A protective resistance of 5 to 25 ohms should always be connected in series with each tube anode, to absorb power-supply stored energy if a plate arc should occur. An electronic crowbar, which will discharge power-supply capacitors in a few microseconds after the start of a plate arc, is recommended.

OPERATING HAZARDS

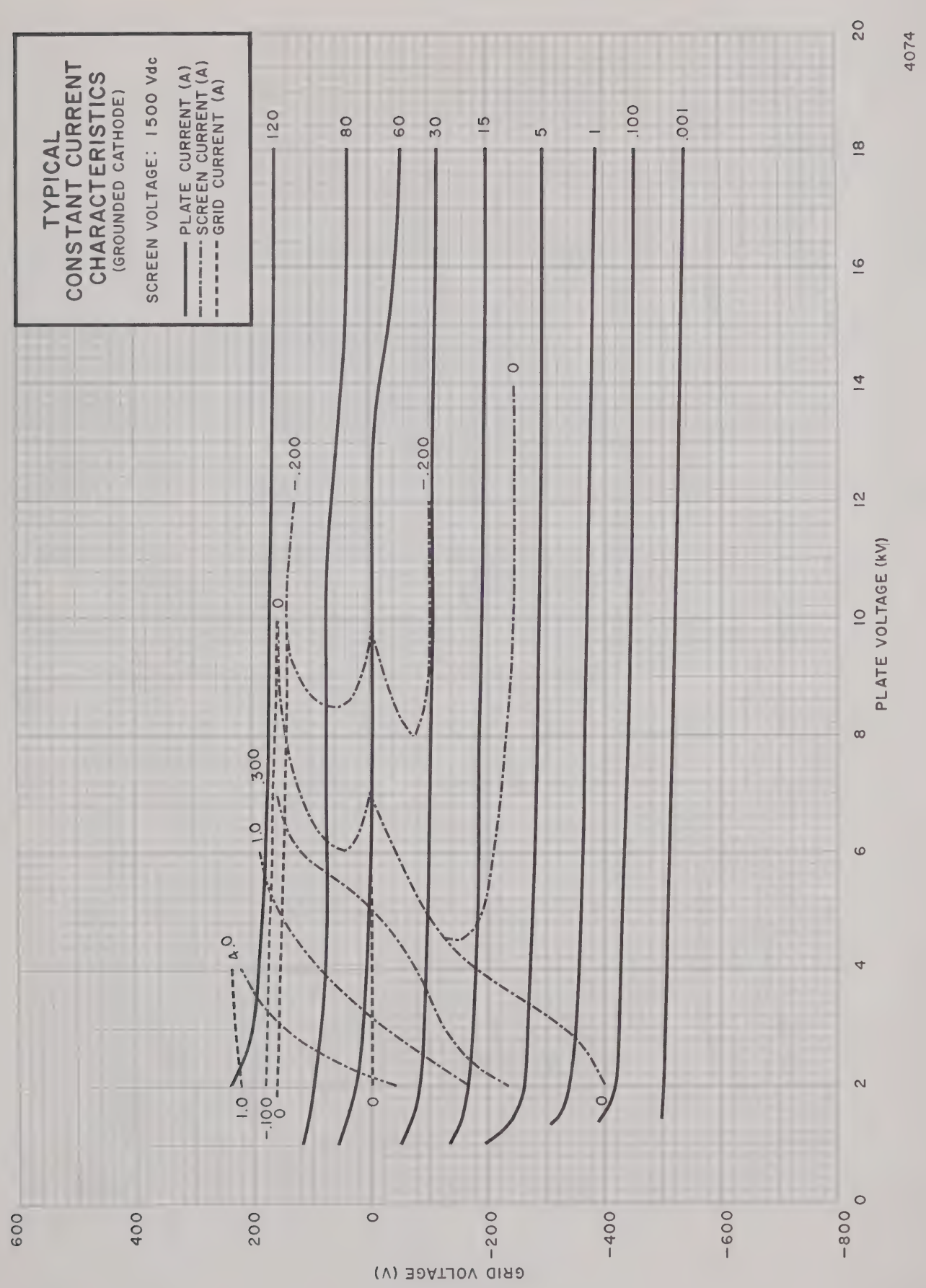
Read the following and take all necessary precautions to safeguard personnel. Safe operating conditions are the responsibility of the equipment designer and the user.

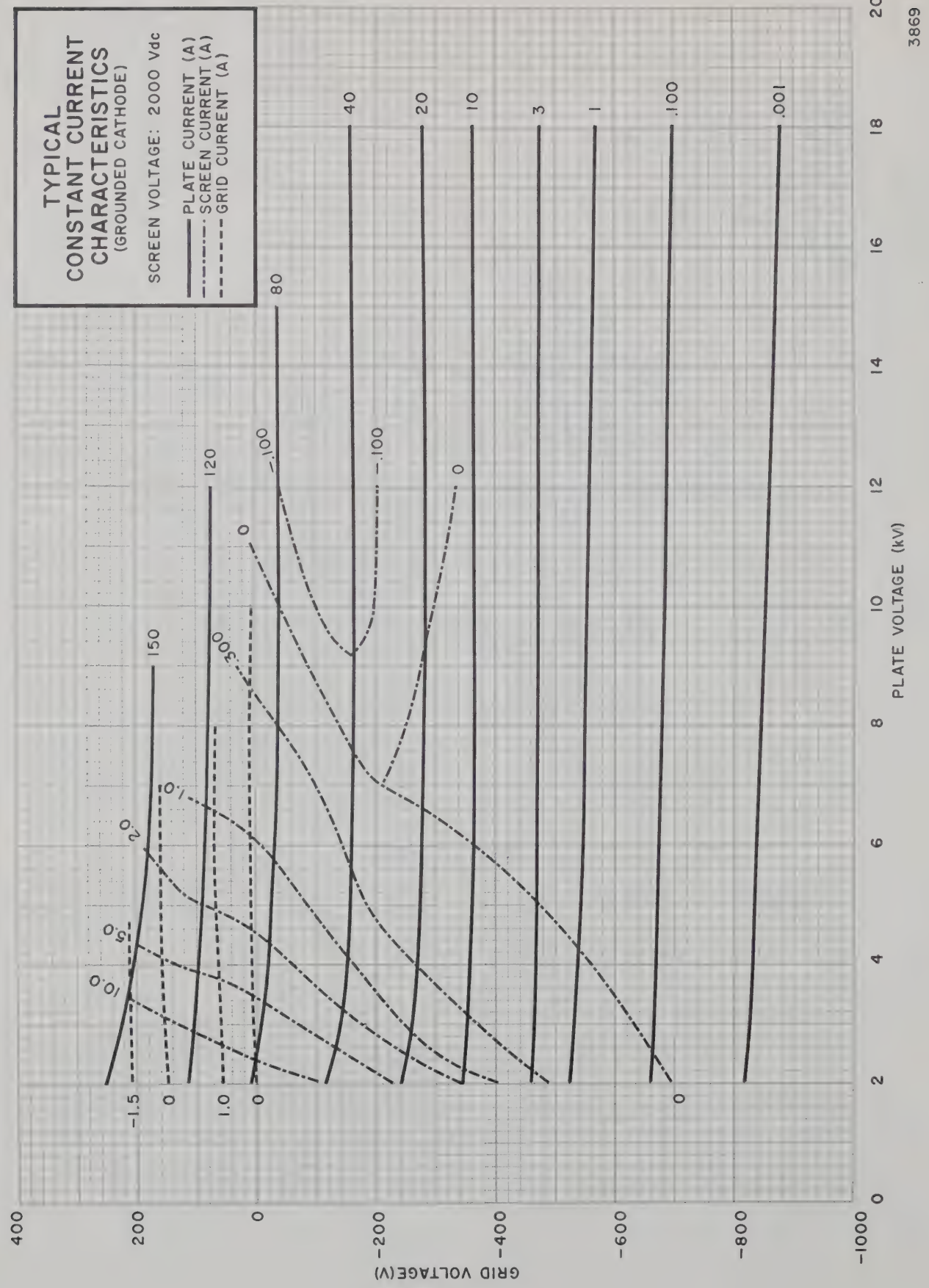
HIGH VOLTAGE — This tube operates at voltages which can be deadly. Equipment must be designed so personnel cannot come in contact with operating voltages. Enclose high-voltage circuits and terminals and provide fail-safe interlocking switch circuits to open the primary circuits of the power supply and to discharge high-voltage condensers whenever access into the enclosure is required.

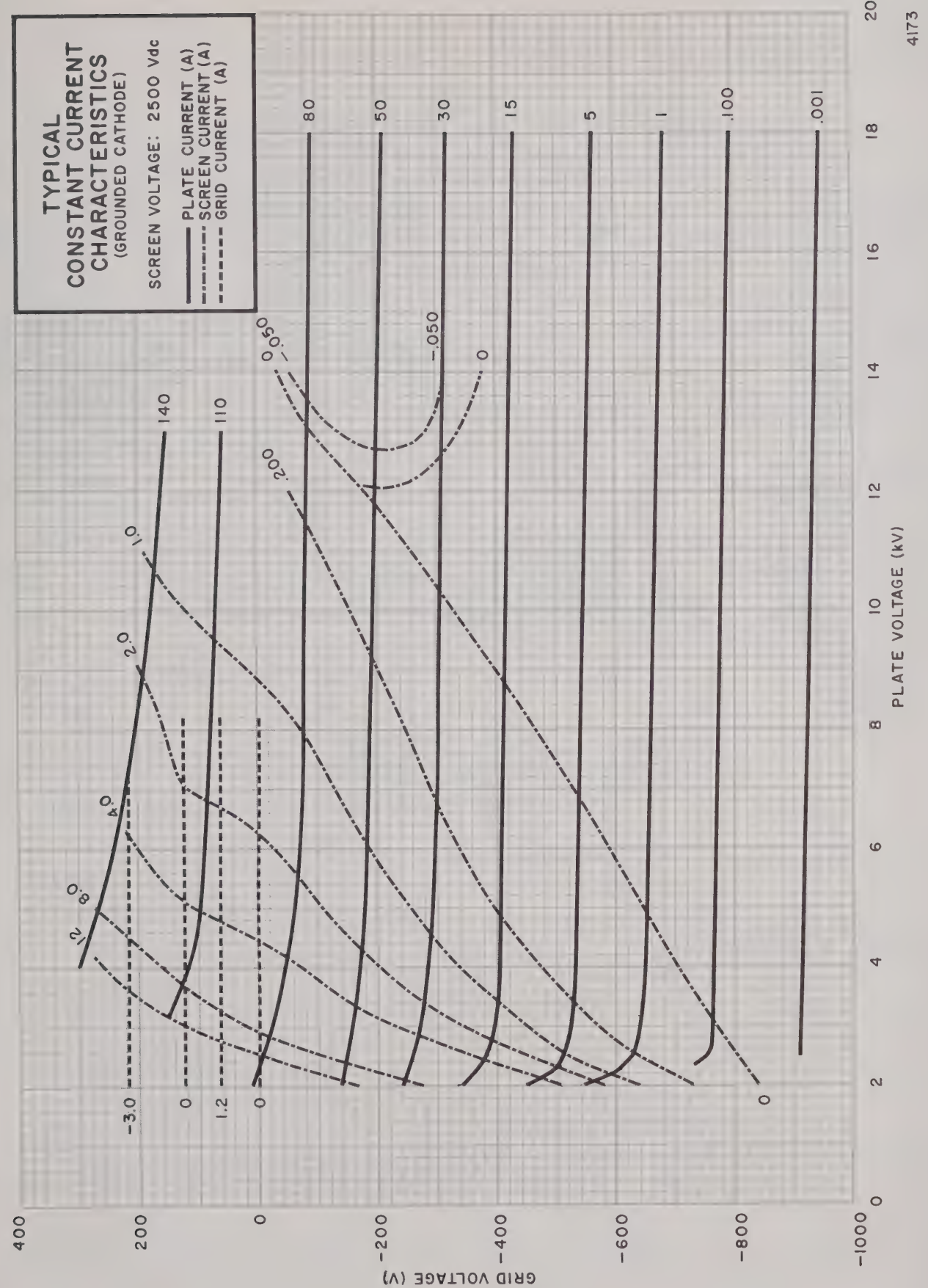
X-RAY RADIATION — The 4CW100,000E, operating at its rated voltages and currents, is a potential X-ray hazard. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to changes in leakage paths or emission characteristics as they are affected by high voltage. Only limited shielding is afforded by the tube envelope. Additional X-ray shielding must be provided on all sides of the tube to provide adequate protection to operating personnel throughout the tube's life. When this tube is used as a pulse modulator, shielding of the pulse transformer may also be necessary. X-ray caution signs or labels must be permanently attached to equipment using this tube directing operating personnel never to operate this device without X-ray shielding in place.

RADIO FREQUENCY RADIATION — Exposure of the human body to rf radiation becomes increasingly more hazardous as the power level and/or frequency are increased. Exposure to high-power rf radiation must be strictly prevented at any frequency.

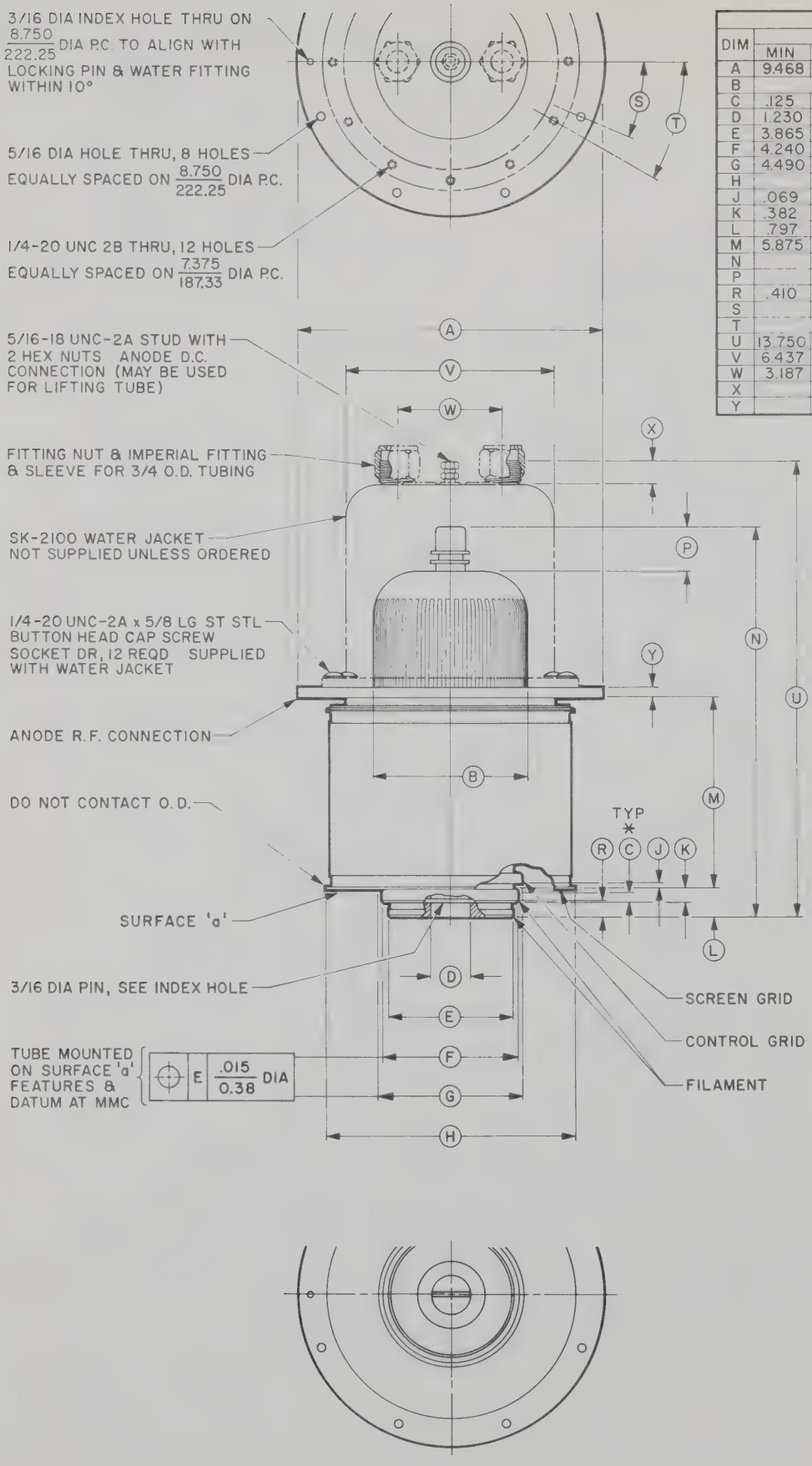
Equipment must be designed to fully safeguard all personnel from these hazards. Labels and caution notices must be provided on equipment and in manuals clearly warning of these hazards.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED CATHODE)
SCREEN VOLTAGE: 1500 Vdc
PLATE CURRENT (A)
SCREEN CURRENT (A)
GRID CURRENT (A)
120
80
60
30
15
5
1
.100
.001
0
-.200
4.0
1.0
.300
-.100
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
4074


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED CATHODE)
SCREEN VOLTAGE: 2000 Vdc
PLATE CURRENT (A)
SCREEN CURRENT (A)
GRID CURRENT (A)
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
3869


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED CATHODE)
SCREEN VOLTAGE: 2500 Vdc
PLATE CURRENT (A)
SCREEN CURRENT (A)
GRID CURRENT (A)
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
4173
400
200
0
-200
-400
-600
-800
-1000
0
2
4
6
8
10
12
14
16
18
20
140
110
80
50
30
15
5
1
.100
.001
12
8.0
4.0
2.0
1.0
.200
.050
0
-.050
-3.0
0
1.2
0

OUTLINE DRAWING



DIM	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN	MAX	REF
A	9.468	9.531		240.49	242.09	
B			5.000			127
C	.125			3.18		
D	1.230	1.270		31.24	32.26	
E	3.865	3.885		98.17	98.68	
F	4.240	4.260		107.7	108.2	
G	4.490	4.510		114.05	114.55	
H			7.750			196.85
J	.069	.149		1.75	3.79	
K	.382	.462		9.70	11.74	
L	.797	.922		20.24	23.42	
M	5.875	6.000		149.23	152.6	
N			11.500			292.1
P			1.375			34.93
R	.410	.475		10.41	12.07	
S			22 1/2°			—
T			30°			—
U	13.750	14.250		349.25	361.95	
V	6.437	6.562		163.7	166.88	
W	3.187	3.313		80.95	84.15	
X			.562			14.28
Y			.312			7.93

REF DIMENSIONS ARE FOR INFORMATION ONLY

(*) MINIMUM CONTACT SURFACE

4CW250,000V
4CW250,000A

TECHNICAL DATA

WATER-COOLED
POWER TETRODE

The EIMAC 4CW250,000V/A is a ceramic/metal, water-cooled, power tetrode intended for use at the 250 to 500 kilowatt output power level. It is recommended as a Class C amplifier or oscillator; a Class AB rf linear amplifier; a Class AB push-pull af amplifier or modulator; a plate or screen modulated Class C rf amplifier; or for pulse modulator or regulator service.

The 4CW250,000V is supplied with a VacIon®pump attached. On the 4CW-250,000A, no VacIon pump is attached.



Shown with anode water jacket.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	12.0 ± 0.6 V
Current, at 12.0 volts	660 A
Amplification Factor (Average):	
Grid to Screen	4.5
Direct Interelectrode Capacitance (grounded cathode) [2]	
Cin	765 pF
Cout	124 pF
Cgp	6.0 pF
Frequency or Maximum Rating:	
CW	50 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube.

MECHANICAL

Maximum Overall Dimensions:	
Length (4CW250,000V)	32.93 in; 837.0 mm
(4CW250,000A)	30.46 in; 774.0 mm
Diameter	13.06 in; 330.0 mm
Net Weight	98 lb; 44.5 kg
Operating Position	Vertical, base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals	200°C
Cooling	Liquid
Base	Special
Recommended Anode Water Jacket (not supplied)	SK-1720

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Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

TYPICAL OPERATION (Frequencies to 50 MHz)
Class AB, Peak Envelope or Modulation Crest Conditions

Plate Voltage	15	20	kVdc
Screen Voltage	1.8	1.8	kVdc
Grid Voltage [1/2]	-500	-500	Vdc
Zero-Signal Plate Current	0.20	0.20	Adc
Single-Tone Plate Current	20	23	Adc
Single-Tone Screen Current [2]	1.1	1.2	Adc
Peak rf Grid Voltage [2]	500	500	v
Plate Dissipation	80	130	kW
Plate Output Power	220	330	kW
Resonant Load Impedance	325	435	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

TYPICAL OPERATION (Frequencies to 50 MHz)

Plate Voltage	16.0	19.0	kVdc
Screen Voltage	800	800	Vdc
Grid Voltage	-800	-800	Vdc
Plate Current	23.5	32.5	Adc
Screen Current [1]	2.4	3.5	Adc
Grid Current [1]	1.15	2.5	Adc
Calculated Driving Power	2.24	3.00	kW
Plate Dissipation	100.0	155.0	kW
Plate Output Power	275.0	460.0	kW
Resonant Load Impedance	300	275	Ω

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER

Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	17,500	VOLTS
DC SCREEN VOLTAGE	2,000	VOLTS
DC PLATE CURRENT	30	AMPERES
PLATE DISSIPATION [1]	167,000	WATTS
SCREEN DISSIPATION [2]	3,500	WATTS
GRID DISSIPATION [2]	1,500	WATTS

1. Corresponds to 250,000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 50 MHz)

Plate Voltage	14.0	kVdc
Screen Voltage	800	Vdc
Grid Voltage	-800	Vdc
Plate Current	29.0	Adc
Screen Current [1]	3.5	Adc
Grid Current [1]	2.0	Adc
Peak af Screen Voltage [1] (100% modulation)	800	v
Peak rf Grid Voltage [1]	1160	v
Calculated Driving Power	2320	W
Plate Dissipation	119.0	kW
Plate Output Power	285.0	kW
Resonant Load Impedance	210	Ω

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	40	AMPERES
PLATE DISSIPATION	250,000	WATTS
SCREEN DISSIPATION	3,500	WATTS
GRID DISSIPATION	1,500	WATTS

1. Approximate value.

TYPICAL OPERATION (Two Tubes), Sinusoidal Wave

Plate Voltage	15.0	20.0	kVdc
Screen Voltage	1.8	1.8	kVdc
Grid Voltage [1/3]	-500	-500	Vdc
Zero-Signal Plate Current	0.20	0.20	Adc
Max. Signal Plate Current	40.0	46.0	Adc
Max. Signal Screen Current [1]	1.1	1.2	Adc
Peak af Grid Voltage [2]	500	500	v
Max. Signal Plate Dissipation	160.0	260.0	kW
Plate Output Power	440.0	660.0	kW
Load Resistance (plate to plate)	650	870	Ω

2. Per Tube.
3. Adjust to give stated zero-signal plate current.

PULSE MODULATOR OR REGULATOR

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	40,000 VOLTS	PLATE DISSIPATION	250,000 WATTS
DC SCREEN VOLTAGE	2,500 VOLTS	SCREEN DISSIPATION	3,500 WATTS
PEAK CATHODE CURRENT	350 AMPERES	GRID DISSIPATION	1,500 WATTS

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Filament: Current at 12 volts	620	700	A
Interelectrode Capacitances[1] (grounded cathode connection)			
Cin	730	800	pF
Cout	112	136	pF
Cgp	4.0	8.0	pF

1. Capacitance values are for a cold tube.

APPLICATION

MECHANICAL

MOUNTING - The 4CW250,000V/A must be mounted vertically, anode up or down. The tube may be supported by the anode flange or the screen flange.

COOLING - The EIMAC SK-1720 water jacket is available for use with the 4CW250,000A and V. Because of the small size of this cooler, high frequency operation is possible. It is essential that high purity water be used to minimize power loss and corrosion of metal fittings. Good distilled or de-ionized water will have a resistance of 1 to 2 megohms per cm^3. Water should be discarded if resistivity falls to 50,000 ohms cm^3.

Since the tube anode is usually at high potential to ground, water connections to the anode are made through insulating tubing. These insulating sections should be long enough so that column resistance is above 100,000 ohms per 1000 plate supply volts.

The table below lists minimum cooling water requirements at various plate dissipation levels.

Plate Dissipation (kilowatts)	Water Flow (GPM)	Pressure Drop (PSI)
100	25.0	3.5
150	37.5	3.7
200	50.0	4.0
250	60.0	6.0
300	73.0	9.0

The filament supports of the 4CW250,000V/A are water cooled. Approximately 0.5 GPM should circulate through each of the filament connectors with a pressure drop of 20 PSI. Filament connector assemblies, SK-1710, provide electrical and water connections. Two sets of SK-1710 are required.

It is recommended that the water cooled control grid connector, SK-1712, be used. Water flow of approximately 0.5 GPM should circulate through the grid connector. The pressure drop across the grid connector is low. A convenient way to make water connection is to series connect the grid cooling water with the outer filament cooling water path.

The outer filament water path has a lower pressure drop than the inner filament water path making this connection practical.

VacIon ® High Vacuum Pump –
Model 913-0011

This pump is included as standard equipment on the 4CW250,000V. It permits periodic checking of the vacuum condition of tubes in storage. It may be used to restore the vacuum of a tube which has been accidentally damaged by overheating in service.

Accessories required for VacIon ® pump operation but not supplied with the tube are:
Permanent magnet, Model 913-0011.
Control unit, Model 921-0006 for 60 Hz power.
Control unit, Model 921-0026 for 50 Hz power.

ELECTRICAL

FILAMENT OPERATION - The peak emission at rated filament voltage of the EIMAC 4CW-250,000V/A is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CW250,000V/A by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CW250,000V/A. At some value of filament voltage there will be a noticeable reduction in plate current or power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appeared to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked.

Filament starting current must be limited to a maximum of 1800 amperes.

GRID OPERATION - The 4CW250,000V/A grid is rated at 1,500 watts of dissipation and protective measures should be included in circuitry to insure that this rating is not exceeded. Grid dissipation is the approximate product of dc grid current and peak positive grid voltage.

SCREEN DISSIPATION - The power applied to the screen grid must not exceed 3,500 watts. Where no ac is applied to the screen, dissipation is the product of dc screen voltage and dc screen current. With screen modulation the dissipation is the product of RMS screen current and RMS screen voltage.

Plate voltage, plate load and bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to remove screen power at the occurrence of any such conditions.

PLATE DISSIPATION - The plate dissipation of 250 kilowatts attainable through water cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CW250,000V/A is used as a plate-modulated rf amplifier, plate dissipation under carrier conditions is limited to 167,000 watts.

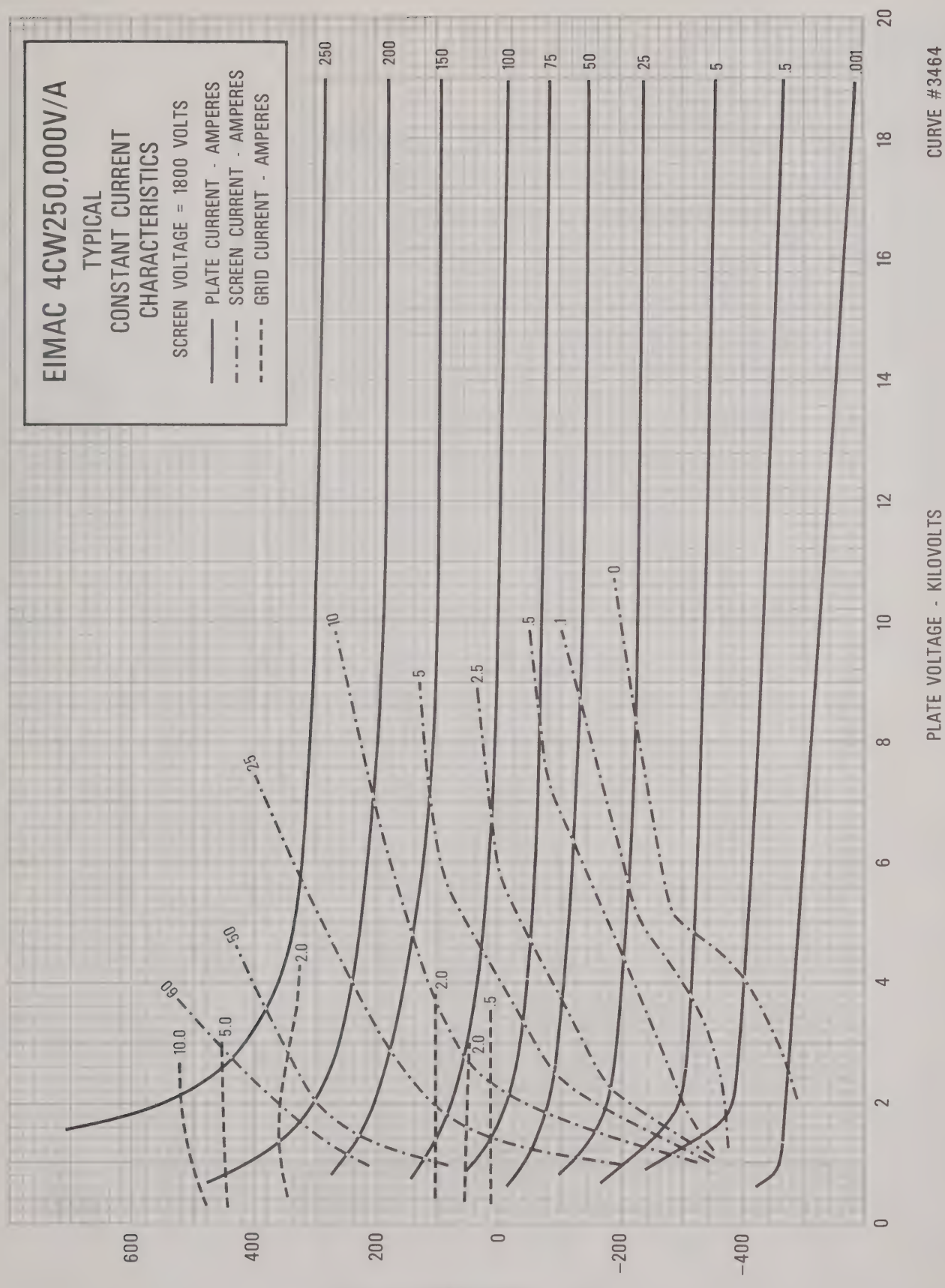
HIGH VOLTAGE - Normal operating voltages used with the 4CW250,000V/A are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

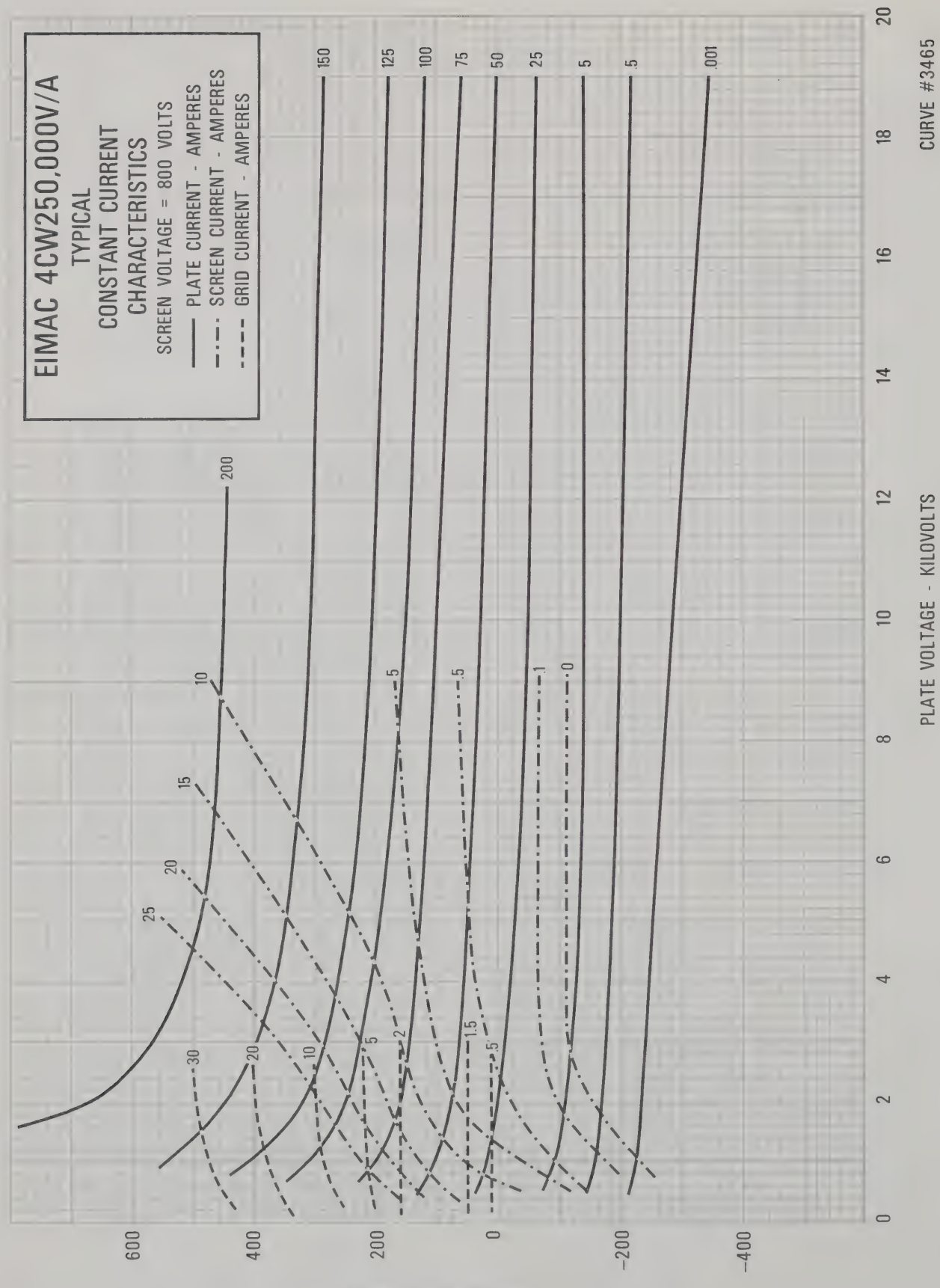
X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CW250,000V/A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

RADIO FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

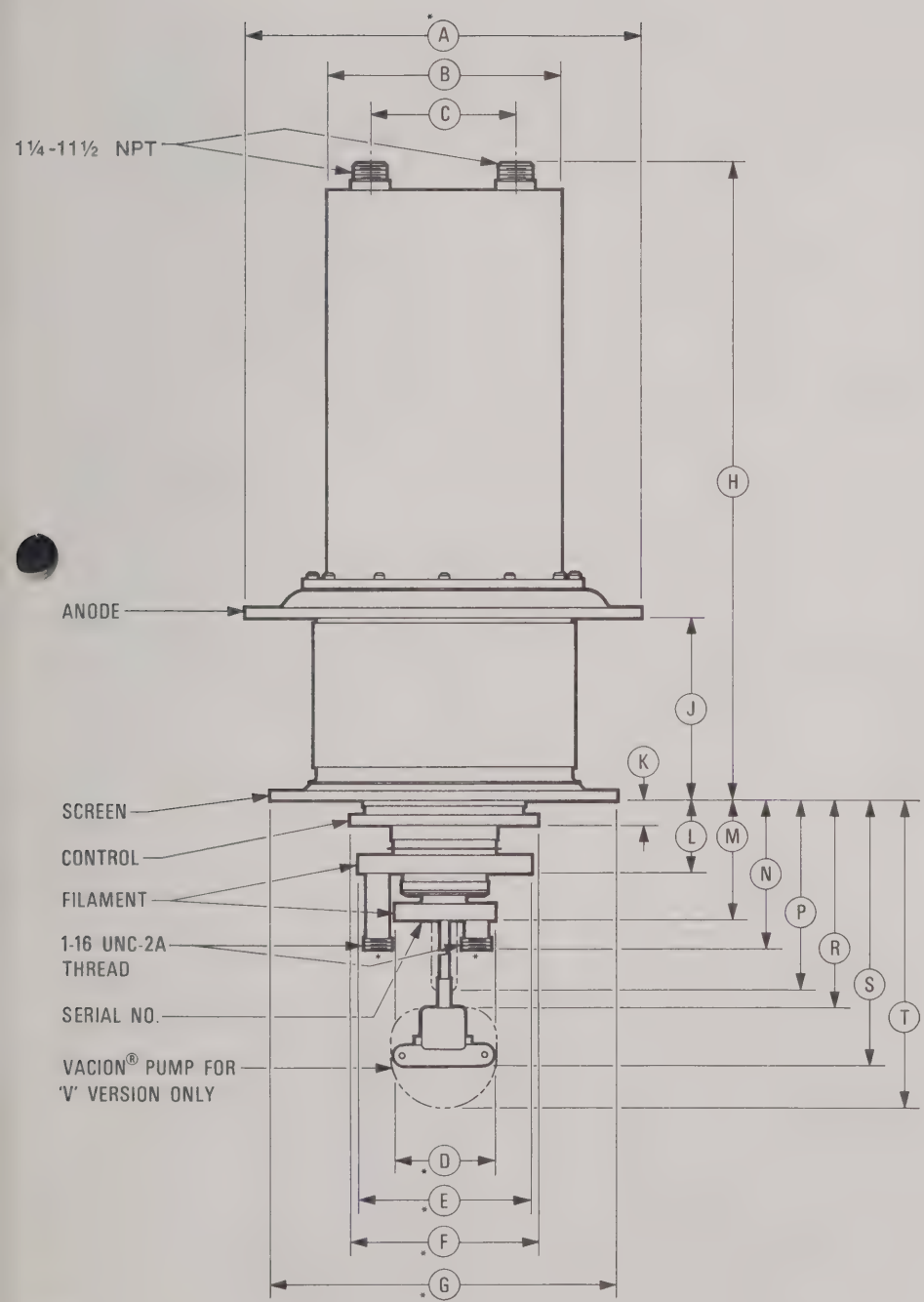
SPECIAL APPLICATION - Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, 94070, for information and recommendations.

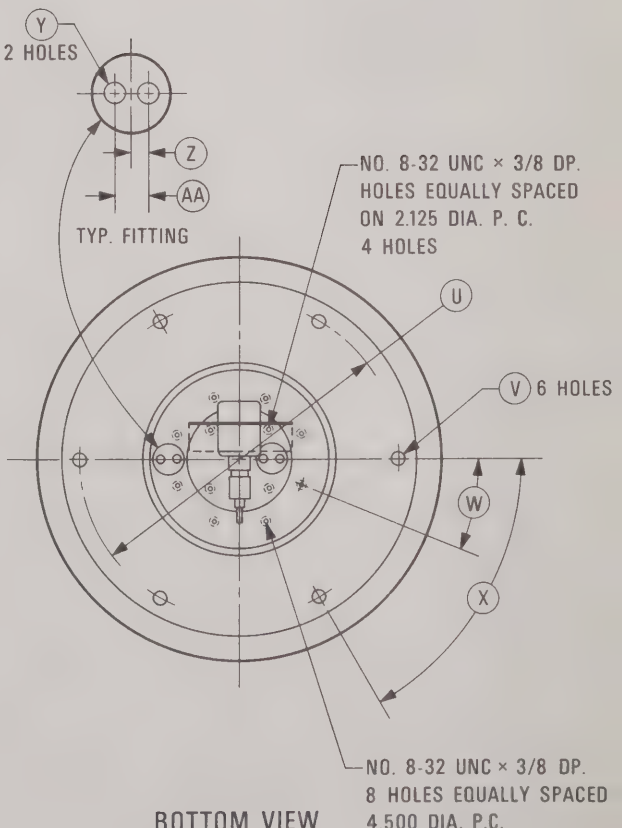

EIMAC 4CW250,000V/A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1800 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
250
200
150
100
75
50
25
5
5
.001
10.0
5.0
2.0
2.0
2.0
.5
.5
.1
0
10
5
2.5
25
50
60
GRID VOLTAGE - VOLTS
600
400
200
0
-200
-400
PLATE VOLTAGE - KILOVOLTS
0
2
4
6
8
10
12
14
16
18
20
CURVE #3464


EIMAC 4CW250,000V/A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 800 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
GRID VOLTAGE - VOLTS
600
400
200
0
-200
-400
PLATE VOLTAGE - KILOVOLTS
0
2
4
6
8
10
12
14
16
18
20
CURVE #3465

DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	12.937	13.062	--	328.60	331.77	--
B	7.937	8.062	--	201.60	204.77	--
C	4.437	4.562	--	112.70	115.87	--
D	3.437	3.562	--	87.30	90.47	--
E	5.937	6.062	--	150.80	153.97	--
F	6.437	6.562	--	163.50	166.67	--
G	11.937	12.062	--	303.20	306.37	--
H	23.437	23.562	--	595.30	598.47	--
J	6.250	6.375	--	158.75	161.93	--
K	0.750	0.875	--	19.05	22.23	--
L	2.437	2.562	--	61.90	65.07	--
M	4.062	4.187	--	103.17	106.35	--
N	5.000	5.125	--	127.00	130.18	--
P	--	6.900	(3)	--	175.26	(3)
R	6.750	7.375	(3)	171.45	187.33	(3)
S	8.750	9.375	(3)	222.25	238.13	(3)
T	--	11.250	(3)	--	285.75	(3)
U	--	--	11.000	--	--	279.40
V	--	--	0.375	--	--	9.53
W	--	--	22.5°	--	--	22.5°
X	--	--	60.0°	--	--	60.0°
Y	--	--	0.261	--	--	6.63
Z	--	--	0.219	--	--	5.56
AA	--	--	0.438	--	--	11.13

NOTES:
1. REF. DIMS. ARE FOR INFO.ONLY AND ARE NOT REQ'D. FOR INSP. PURPOSES.
2. (*) CONTACT SURFACES.
3. 'P' DIM. APPLIES TO 'A' VERSION ONLY. R, S & T DIMS. APPLY TO 'V' VERSION ONLY.





BOTTOM VIEW

EIMAC
Division of Varian

4CW250,000V
4CW250,000A
WATER-COOLED POWER TETRODE

The EIMAC 4CW250,000V/A is a ceramic-metal, water-cooled, power tetrode intended for use at the 250 to 500 kilowatt output power level. It is recommended for use as a Class C amplifier or oscillator; a Class AB r-f linear amplifier; a Class AB push-pull a-f amplifier or modulator; a plate or screen modulated Class C r-f amplifier; or for pulse modulator or regulator service.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage (Max.)	12.0 V
Current	640 A
Amplification Factor (Grid-Screen) (Avg.)	4.5
Direct Interelectrode Capacitance, Grounded Cathode:	
Input	775 pF
Output	130 pF
Feedback	1.2 pF
Frequency for Maximum Ratings	50 MHz

MECHANICAL

Base	Special
Maximum Seal Temperature	200°C
Operation Position	Vertical, base up or down
Maximum Dimensions:	
Height	29½ in.
Diameter	13 in.
Cooling	Liquid
Net Weight	100 lbs.
Shipping Weight (approx.)	310 lbs.

(Effective 10-15-67) © 1967 by Varian

Printed in U.S.A.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down Condition)

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 VOLTS
DC SCREEN VOLTAGE	2,500 VOLTS
DC PLATE CURRENT	40 AMPS
PLATE DISSIPATION	250,000 WATTS
SCREEN DISSIPATION	3,500 WATTS
GRID DISSIPATION	1,500 WATTS

TYPICAL OPERATION (Frequences below 50 MHz)

DC Plate Voltage	16	19 kV
DC Screen Voltage	800	800 Volts
DC Grid Voltage	–800	–800 Volts
DC Plate Current	23.5	32.5 Amps
DC Screen Current	2.4	3.5 Amps
DC Grid Current	1.15	2.5 Amps
Driving Power (Note 1.)	2.24	3.0 kW
Plate Output Power	275	460 kW
Plate Dissipation	100	155 kW
RF Load Impedance	300	275 Ohms

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	17,500 VOLTS
DC SCREEN VOLTAGE	2,000 VOLTS
DC PLATE CURRENT	30 AMPS
PLATE DISSIPATION*	167,000 WATTS
SCREEN DISSIPATION	3,500 WATTS
GRID DISSIPATION	1,500 WATTS

*Corresponds to 250,000 watts at 100 per cent sine wave modulation
**Approximate Value

TYPICAL OPERATION (Frequencies below 50 MHz)

DC Plate Voltage	14 kV
DC Screen Voltage	800 Volts
Peak AF Screen Voltage (For 100% Modulation)**	800 Volts
DC Grid Voltage	–800 Volts
DC Plate Current	29.0 Amps
DC Screen Current	3.5 Amps
DC Grid Current	2.0 Amps
Peak RF Grid Voltage	1160 Volts
Grid Driving Power (Note 1.)	2320 Watts
Plate Output Power	285 kW
RF Load Impedance	210 Ohms
Plate Dissipation	119 kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	20,000 VOLTS
DC SCREEN VOLTAGE	2,500 VOLTS
DC PLATE CURRENT	40 AMPS
PLATE DISSIPATION	250,000 WATTS
SCREEN DISSIPATION	3,500 WATTS
GRID DISSIPATION	1,500 WATTS

*Approximate Value
**Per Tube

TYPICAL OPERATION (Two Tubes Class AB_1)

DC Plate Voltage	15	20 kV
DC Screen Voltage	1.8	1.8 kV
DC Grid Voltage	–500	–500 Volts
Max-Signal Plate Current	40	46 Amps
Zero Signal Plate Current**	0.2	0.2 Amps
Max-Signal Screen Current*	1.1	1.2 Amps
Peak AF Driving Voltage**	500	500 Volts
Driving Power	0	0 Watts
Load Impedance (Plate to Plate)	650	870 Ohms
Plate Dissipation	160	260 kW
Max-Signal Output Power	440	660 kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 VOLTS
DC SCREEN VOLTAGE	2,500 VOLTS
DC PLATE CURRENT	40 AMPS
PLATE DISSIPATION	250,000 WATTS
SCREEN DISSIPATION	3,500 WATTS
GRID DISSIPATION	1,500 WATTS

*Approximate

TYPICAL OPERATION
Class AB_1 Peak-Envelope or Modulation Crest Conditions (Frequencies below 50 MHz)

DC Plate Voltage	15	20 kV
DC Screen Voltage	1.8	1.8 kV
DC Grid Voltage	–500	–500 Volts
Plate Current	20	23 Amps
Zero Signal Plate Current	0.2	0.2 Amps
Maximum Signal Screen Current*	1.1	1.2 Amps
Peak RF Grid Voltage	500	500 Volts
Driving Power (Note 1.)	0	0 Watts
Plate Dissipation	80	130 kW
Resonant Load Impedance	325	435 Ohms
Plate Output Power	220	330 kW

PULSE MODULATOR OR REGULATOR

MAXIMUM RATINGS

DC PLATE VOLTAGE	40,000 VOLTS
DC SCREEN VOLTAGE	2,500 VOLTS
PEAK CATHODE CURRENT	350 AMPS
PLATE DISSIPATION	250,000 WATTS
SCREEN DISSIPATION	3,500 WATTS
GRID DISSIPATION	1,500 WATTS

Note 1.—Calculated Driving Power Neglects Input conductance and RF circuit loss.

APPLICATION

MECHANICAL

Mounting—The 4CW250,000V/A must be mounted vertically, anode up or down. The tube may be supported by the anode flange or the screen flange.

Cooling—The 4CW250,000V/A has a high efficiency integral anode cooler; because of the small size of this cooler, high frequency operation is possible. It is essential that high purity water be used to minimize power loss and corrosion of metal fittings. Good distilled or de-ionized water will have a resistance of 1 to 2 meg ohms per cm^3. Water should be discarded if resistivity falls to 50,000 ohms cm^3.

Since the tube anode is usually at high potential to ground, water connections to anode are made through insulating tubing. These insulating sections should be long enough so that column resistance is above 100,000 ohms per 1000 plate supply volts.

The table below lists minimum cooling water requirements at various plate dissipation levels.

Plate Dissipation (kilowatts)	Water Flow (GPM)	Pressure Drop (PSI)
100	25.0	3.2
150	37.5	5.1
200	50.0	7.3
250	60.0	10.0
300	73.0	13.2

The filament supports of the 4CW250,000V/A are water cooled. Approximately .5 GPM should circulate through each of the filament connectors with a pressure drop of 20 PSI. Filament connector assemblies, SK-1710, provide electrical and water connections. Two sets of SK-1710 are required.

It is recommended that the water cooled control grid connector, SK-1712, be used. Water flow of approximately .5 GPM should circulate through the grid connector. The pressure drop across the grid connector is low. A convenient way to make water connection is to series connect the grid cooling water with the outer filament cooling water path.

The outer filament water path has a lower pressure drop than the inner filament water path making this connection practical.

VacIon® High Vacuum Pump—
Model 913-0011

This pump is included as standard equipment on the 4CW250,000V. It permits periodic checking of the vacuum condition of tubes in storage. It may be used to restore the vacuum of a tube which has been accidentally damaged by overheating in service.

Accessories required for VacIon® pump operation but not supplied with the tube are:

Permanent magnet, Model 913-0011.

Control unit, Model 921-0006 for 60 Hz power.

Control unit, Model 921-0026
for 50 Hz power.

ELECTRICAL

Filament Operation—The peak emission at rated filament voltage of the EIMAC 4CW250,000V/A is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CW250,000V/A by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CW250,000V/A. At some value of filament voltage there will be a noticeable reduction in plate current or power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appeared to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked.

Filament starting current must be limited to a maximum of 1800 amperes.

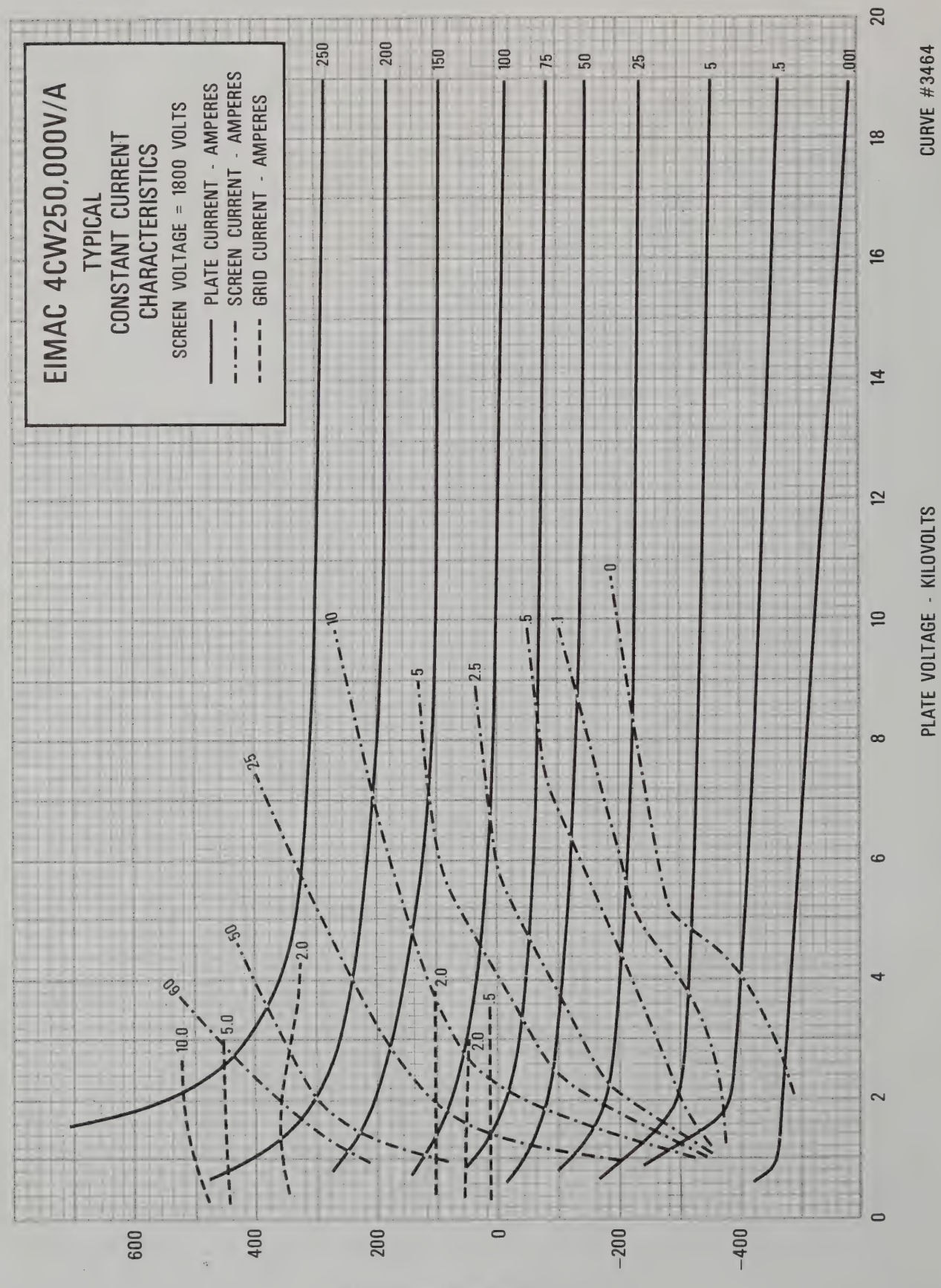
Control Grid Operation—The 4CW250,000V/A control grid is rated at 1,500 watts of dissipation and protective measures should be included in circuitry to insure that this rating is not exceeded. Grid dissipation is the approximate product of d-c grid current and peak positive grid voltage.

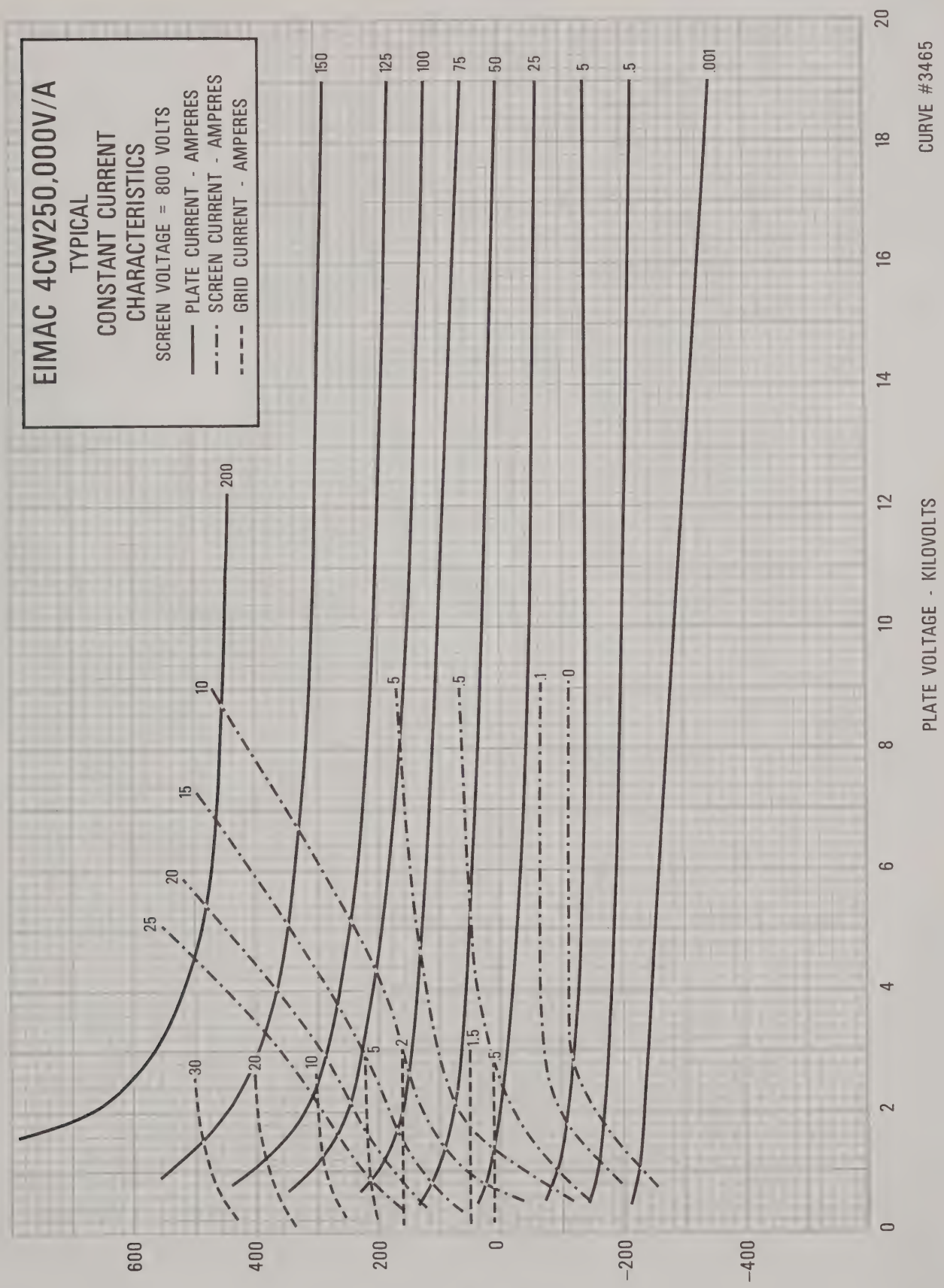
Screen Dissipation—The power applied to the screen grid must not exceed 3,500 watts. Where no a-c is applied to the screen, dissipation is the product of d-c screen voltage and d-c screen current. With screen modulation the dissipation is the product of RMS screen current and RMS screen voltage.

Plate voltage, plate load and bias voltage must never be removed while filament and screen voltages are present since the screen dissipation rating will be exceeded. Suitable protective means must be provided to remove screen power or limit screen power at the occurrence of any such conditions.

Plate Dissipation—The plate dissipation of 250 kilowatts attainable through water cooling provides a large margin of safety in most applications. The rating may be exceeded for brief periods during tuning. When the 4CW250,000V/A is used as a plate-modulated r-f amplifier, plate dissipation under carrier conditions is limited to 167,000 watts.

Special Application—Where it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

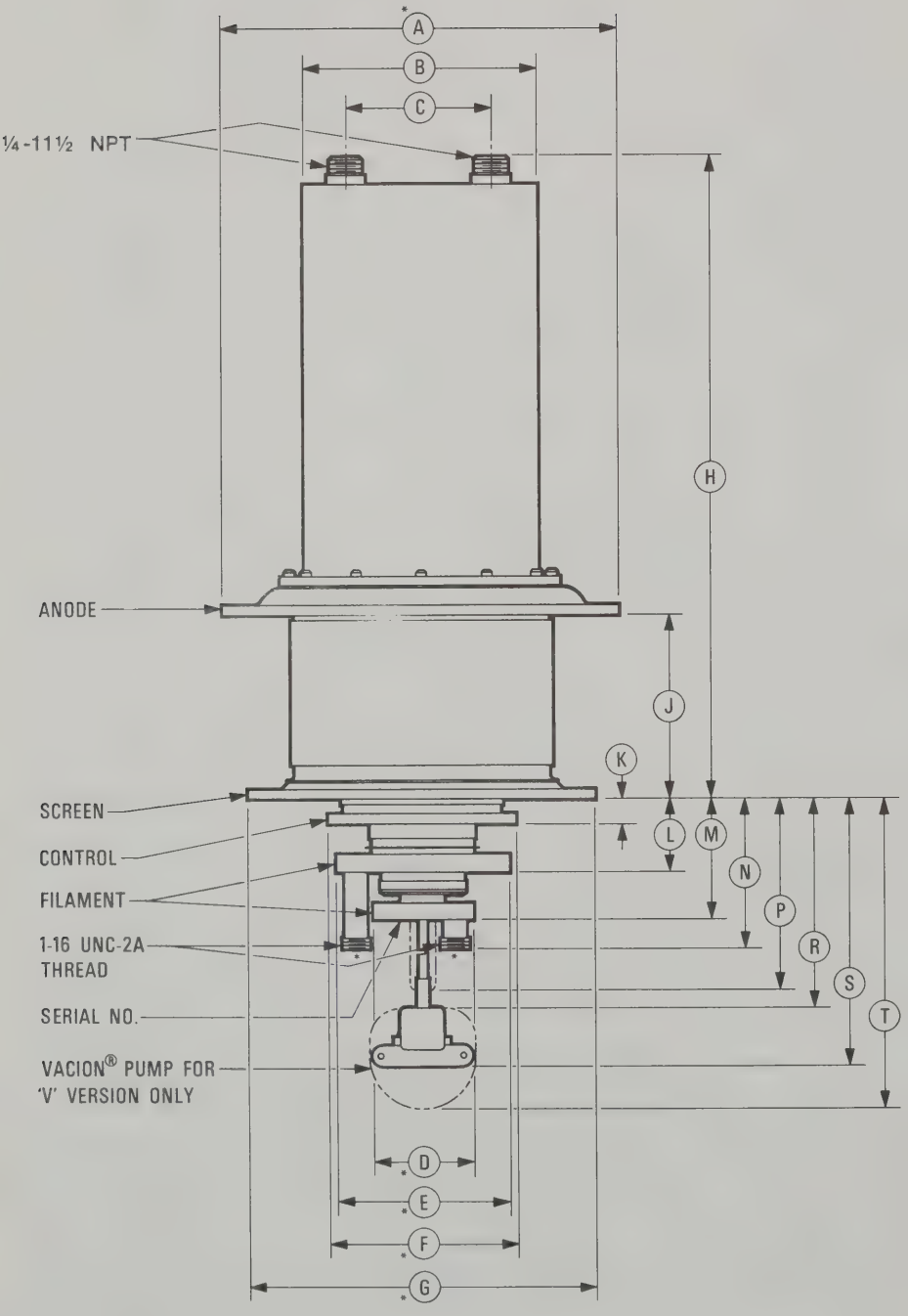

EIMAC 4CW250,000V/A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1800 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
GRID VOLTAGE - VOLTS
PLATE VOLTAGE - KILOVOLTS
CURVE #3464

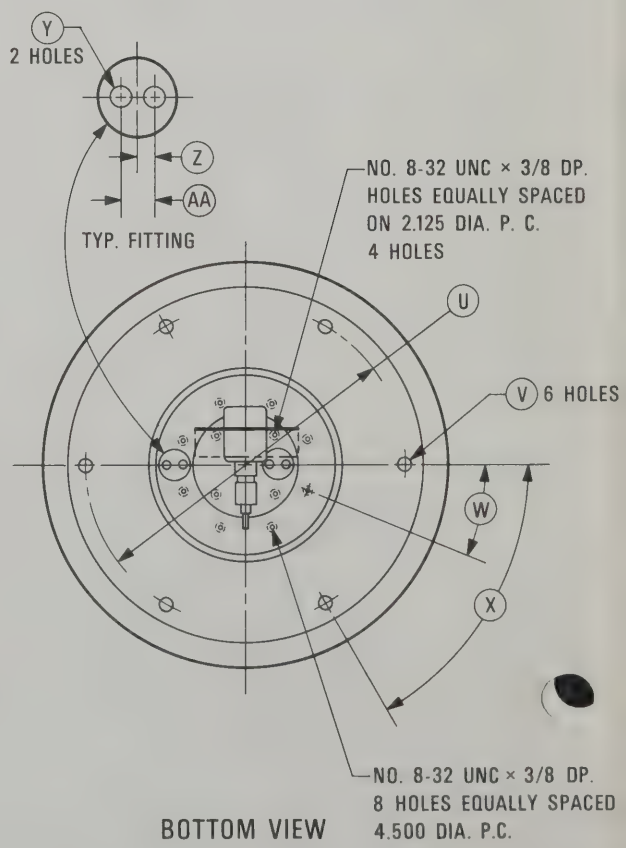

EIMAC 4CW250,000V/A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 800 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
GRID VOLTAGE - VOLTS
PLATE VOLTAGE - KILOVOLTS
CURVE #3465

DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	12.937	13.062	
B	7.937	8.062	
C	4.437	4.562	
D	3.437	3.562	
E	5.937	6.062	
F	6.437	6.562	
G	11.937	12.062	
H	23.437	23.562	
J	6.250	6.375	
K	.750	.875	
L	2.437	2.562	
M	4.062	4.187	
N	5.000	5.125	
P		6.900	NOTE 3
R	6.750	7.375	NOTE 3
S	8.750	9.375	NOTE 3
T		11.250	NOTE 3
U			11.000
V			.375
W			22 1/2°
X			60°
Y			.261
Z			.219
AA			.438

NOTES:
1. REF. DIMS. ARE FOR INFO.ONLY AND ARE NOT REQ'D. FOR INSP. PURPOSES.
2. (*) CONTACT SURFACES.
3. 'P' DIM. APPLIES TO 'A' VERSION ONLY. R, S & T DIMS. APPLY TO 'V' VERSION ONLY.





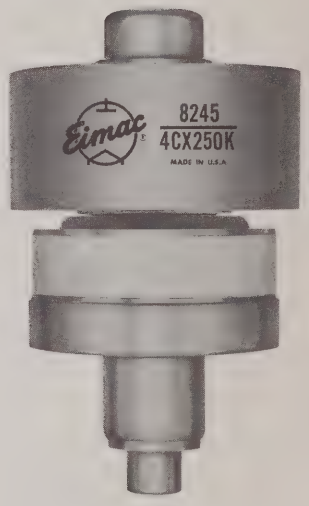
BOTTOM VIEW

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

8245
4CX250K
8246
4CX250M

RADIAL-BEAM POWER TETRODE



The 8245/4CX250K and 8246/4CX250M are compact, forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 8245/4CX250K is designed to operate with a heater voltage of 6.0 volts, while the 8246/4CX250M is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.

These tubes are of coaxial construction and are especially designed for cavity operation.

GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-Coated, Unipotential				
	Heating Time	30	60		seconds
	Cathode-to-heater Potential			±150	volts
Heater:	Voltage 4CX250K		6.0		volts
	Current 4CX250K	2.30		3.0	amperes
	Voltage 4CX250M		26.5		volts
	Current 4CX250M	0.35		0.68	amperes
Amplification Factor (Grid-to-Screen)			5		
Direct Interelectrode Capacitances, Grounded Cathode:					
	Input	25.0		29.0	uuf
	Output	4.2		5.2	uuf
	Feedback			0.05	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen	Min.	Max.	
Input	14.5	19	uuf
Output	4.2	5.2	uuf
Feedback		0.01	uuf
Frequency for Maximum Ratings (CW)		500	Mc
(Pulsed)		1500	Mc

MECHANICAL

Base	Coaxial
Maximum Operating Temperatures:	
Ceramic-to-Metal-Seals	250°C
Anode Core	250°C
Operating Position	Any
Maximum Dimensions:	
Height	2.813 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4.6 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)
MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	300 MAX. VOLTS
DC GRID VOLTAGE	–250 MAX. VOLTS
DC PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

	Frequencies up to 175Mc				500Mc	
DC Plate Voltage	500	1000	1500	2000	2000	volts
DC Screen Voltage	250	250	250	250	300	volts
DC Grid Voltage	—90	—90	—90	—90	—90	volts
DC Plate Current	250	250	250	250	250	mA
DC Screen Current*	45	38	21	19	10**mA	
DC Grid Current*	35	31	28	26	25**mA	
Peak RF Grid Voltage*	114	114	112	112	—	volts
Driving Power*	4.0	3.5	3.2	2.9	—	watts
Plate Input Power	125	250	375	500	500	watts
Plate Output Power	70	190	280	390	225**watts	
Heater Voltage	6.0	6.0	6.0	6.0	5.5	volts

*Approximate values.

**Measured values for a typical cavity amplifier circuit.

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PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500 MAX. VOLTS
DC SCREEN VOLTAGE	300 MAX. VOLTS
DC GRID VOLTAGE	–250 MAX. VOLTS
DC PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc)

DC Plate Voltage	500	1000	1500 volts
DC Screen Voltage	250	250	250 volts
DC Grid Voltage	—100	—100	—100 volts
DC Plate Current	200	200	200 mA
DC Screen Current*	31	22	20 mA
DC Grid Current*	15	14	14 mA
Peak RF Grid Input Voltage*	118	117	117 volts
Driving Power*	1.8	1.7	1.7 watts
Plate Input Power	100	200	300 watts
Plate Output Power	60	145	235 watts

*Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1250 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC GRID VOLTAGE	–250 MAX. VOLTS
DC PLATE CURRENT (AVERAGE)	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 216 Mc., 5-Mc. bandwidth)

DC Plate Voltage	750	1000	1250 volts
DC Screen Voltage	300	300	300 volts
DC Grid Voltage	—60	—65	—70 volts
During Sync-Pulse Peak:			
DC Plate Current	335	330	305 mA
DC Screen Current	50	45	45 mA
DC Grid Current	15	20	25 mA
Peak RF Grid Voltage	85	95	100 volts
RF Driver Power (approx.)	7	8	9 watts
Useful Power Output	135	200	250 watts
Black Level:			
DC Plate Current	245	240	230 mA
DC Screen Current	20	15	10 mA
DC Grid Current	4	4	4 mA
Peak RF Grid Voltage (approx.)	65	70	75 volts
RF Driver Power (approx.)	4.25	4.7	5.5 watts
Plate Power Input	185	240	290 watts
Useful Power Output	75	110	140 watts

PLATE PULSED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

PULSED PLATE VOLTAGE	7000 MAX. VOLTS
PULSED SCREEN VOLTAGE	1500 MAX. VOLTS
DC GRID VOLTAGE	–500 MAX. VOLTS
MAXIMUM PULSE DURATION	5 MICROSECONDS
PULSED CATHODE CURRENT	7 MAX. AMPS
AVERAGE POWER INPUT	250 MAX. WATTS
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL PULSE OPERATION

Single tube oscillator, 1200-Mc.

Pulsed Plate Voltage	5	7 kV
Pulsed Plate Curent	4.0	6.0 amps
Pulsed Screen Voltage	800	1200 volts
Pulsed Screen Current	0.3	0.4 amps
DC Grid Voltage	—200	—250 volts
Pulsed Grid Current	0.5	0.6 amps
Pulse Duration	4	5 μsec
Pulse Repetition Rate	2500	1000 pps
Peak Power Output	7	17 kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 MAX. VOLTS
DC SCREEN VOLTAGE	400 MAX. VOLTS
DC PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc, peak-envelope conditions except where noted)

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	350	350	350 volts
DC Grid Voltage*	—55	—55	—55 volts
Zero-Signal DC Plate Current	100	100	100 mA
Peak RF Grid Voltage**	50	50	50 volts
DC Plate Current	250	250	250 mA
DC Screen Current**	10	8	5 mA
Plate Input Power	250	375	500 watts
Plate Output Power	120	215	300 watts
Two-Tone Average DC Plate Current	190	190	190 mA
Two-Tone Average DC Screen Current**	2	—1	—2 mA

*Approximate values.

**Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4CX250K and 4CX350M may be mounted in any position. The concentric arrangements of the electrode terminals permits the use of the tube in coaxial line or cavity type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

Cooling—Sufficient forced-air cooling must be provided to maintain the anode core and seal temperatures below 250°C. Special care must be observed to insure that there is adequate cooling in the area of the coaxial filament and grid terminals. The table below lists the minimum cooling requirements at sea level with 50°C ambient air to maintain 225°C on the anode. For operation at 10,000 feet, the air-flow values should be multiplied by 1.46.

	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
Plate Dissipation (Watts)	Air Flow (CFM)	Static Pressure (inches of water)	Air Flow (CFM)	Static Pressure (inches of water)
150	3.5	0.3	3.1	0.2
200	4.3	0.4	4.6	0.4
250	5.5	0.7	6.1	0.7

ELECTRICAL

Heater—The rated heater voltages for the 4CX250K and 4CX250M are 6.0 and 26.5 volts, respectively and should be maintained at these values plus or minus five percent. At frequencies above 300 megacycles, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the following table. Further reduction in filament voltage may be needed in pulse service above 500 Mc.

Frequency, Mc	4CX250K	4CX250M
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode — The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Grid Dissipation—Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 Mc, drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 Mc in a "straight through" amplifier is indicated by grid currents below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation—The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

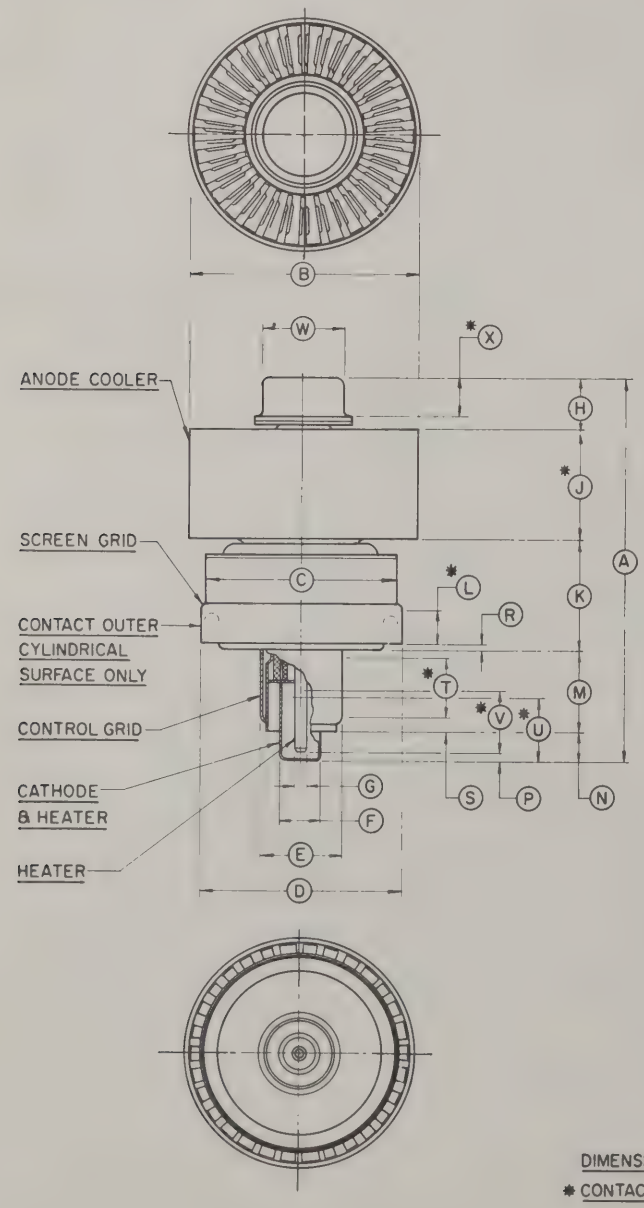
Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4CX250K or 4CX250M.

Plate Operation—The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate-dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

UHF Operation—The 4CX250K and 4CX250M are suitable for use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

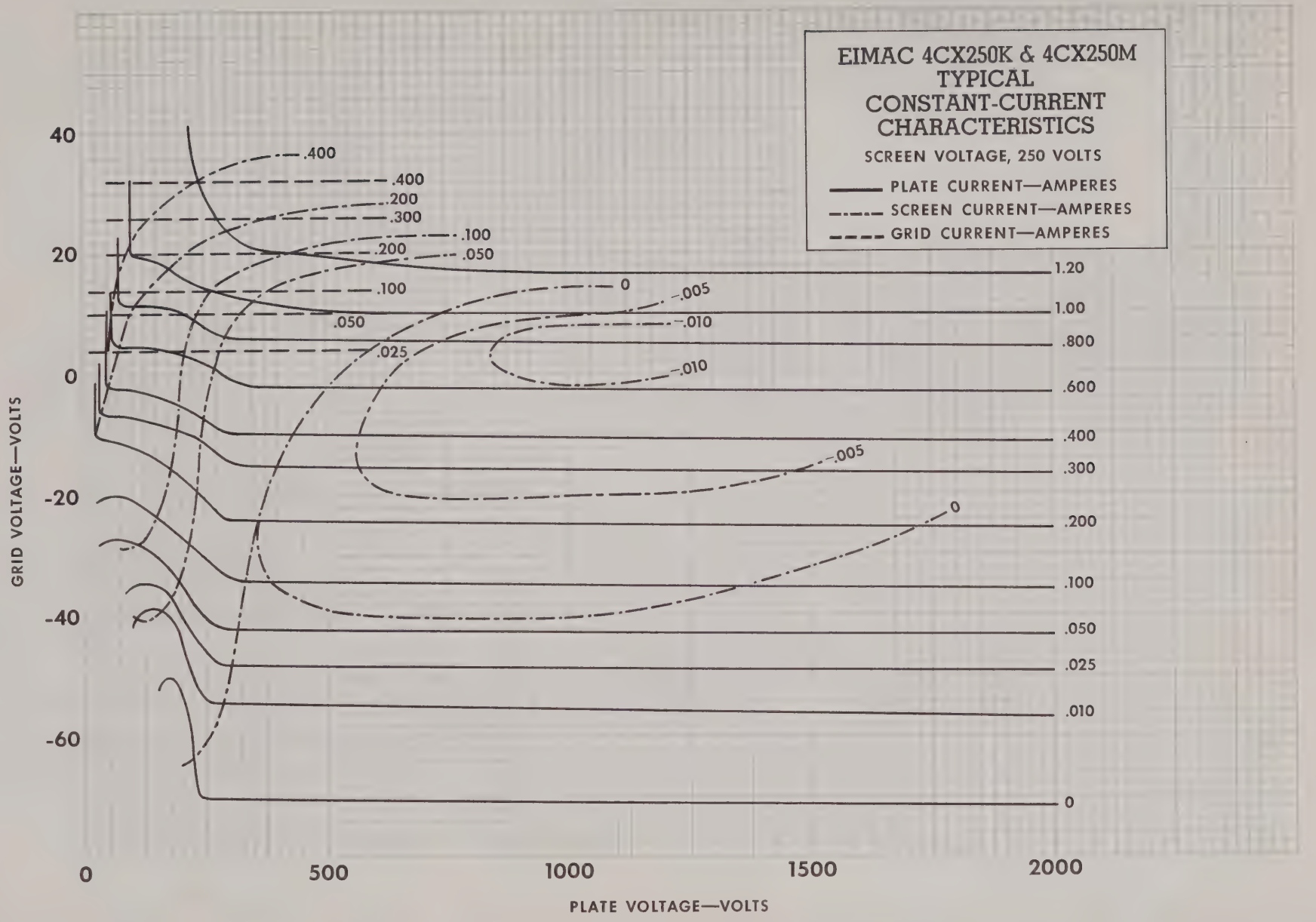
Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias or screen voltage to equalize the inputs.
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

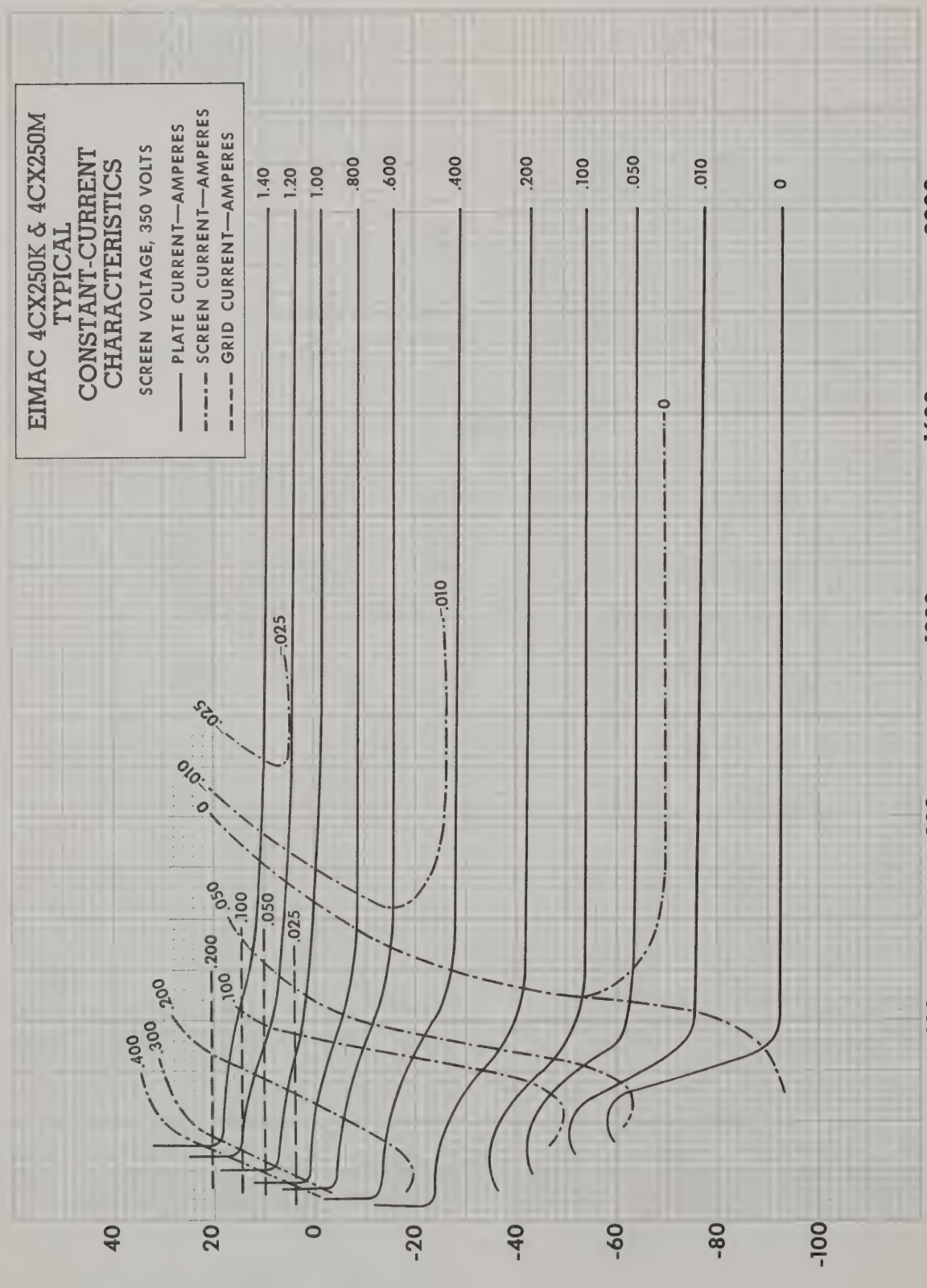
Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough Inc., San Carlos, California, for information and recommendations.



DIMENSIONS		
REF.	MIN.	MAX.
A		2.813
B	1.610 DIA.	1.640 DIA.
C		1.406 DIA.
D	1.410 DIA.	1.440 DIA.
E	.587 DIA.	.597 DIA.
F	.317 DIA.	.327 DIA.
G	.088 DIA.	.098 DIA.
H		.358
J	.710	.790
K	.740	.820
L	.187	
M	.500	.580
N	.235	.265
P	.032	.062
R	.020 NOM.	
S	.125 NOM.	
T	11/32	
U	13/32	
V	15/32	
W	.559	.573
X	.240	.280

DIMENSIONS IN INCHES
* CONTACT SURFACE


EIMAC 4CX250K & 4CX250M
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
0
500
1000
1500
2000
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.400
.400
.200
.300
.100
.200
.050
.100
.050
.025
0
.005
.010
.010
.005
0


EIMAC 4CX250K & 4CX250M
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.025
.010
0
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS

EIMAC
Division of Varian
SAN CARLOS CALIFORNIA

7203 / 4CX250B
7204 / 4CX250F

RADIAL-BEAM POWER TETRODE

The 7203/4CX250B and 7204/4CX250F are ceramic/metal forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 7203/4CX250B is designed to operate with a heater voltage of 6.0 volts, while the 7204/4CX250F is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage (4CX250B)	6.0 ± 0.3	V
Current, at 6.0 volts	2.6	A
Cathode-Heater Potential, maximum	±150	V
Heater: Voltage (4CX250F)	26.5 ± 1.3	V
Current, at 26.5 volts	0.56	A
Cathode-Heater Potential, maximum	±150	V
Amplification Factor (Average):		
Grid to Screen	5	
Direct Interelectrode Capacitances (Grounded cathode)[2]		
Input	15.7	pF
Output	4.5	pF
Feedback	0.04	pF
Direct Interelectrode Capacitances (grounded grid and screen)[2]		
Input	13	pF
Output	4.5	pF
Feedback	0.01	pF
Frequency of Maximum Rating:		
CW	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.46 in; 62.5 mm
Diameter	1.64 in; 41.7 mm
Net Weight	4 oz; 113 gm
Operating Position	Any

(Revised 5-1-70) © 1962 Varian

Printed in U.S.A.

Maximum Operating Temperature:
- Ceramic/Metal Seals . . . . . 250° C
- Anode Core . . . . . 250° C

Cooling . . . . . Forced Air
Base . . . . . Special 9-pin JEDEC-B8-236
Recommended Socket . . . . . EIMAC SK-600 Series
Recommended Chimney . . . . . EIMAC SK-600 Series

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN (SSB)

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage 1	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	250	250	250	mAdc
Two-Tone Plate Current	190	190	190	mAdc
Single-Tone Screen Current 2	10	8	5	mAdc
Two-Tone Screen Current 2	2	-1	-2	mAdc
Single-Tone Grid Current 2	0	0	0	mAdc
Peak rf Grid Voltage 2	50	50	50	v
Plate Output Power	120	215	300	W
Resonant Load Impedance	2000	3000	4000	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage 1	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Carrier Plate Current	150	150	150	mAdc
Carrier Screen Current	-3	-4	-4	mAdc
Peak rf Grid Voltage 2	25	25	25	v
Plate Output Power	30	50	65	W

1. Adjust to specified zero-signal dc plate current

2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)

					500 MHz 2	
Plate Voltage	500	1000	1500	2000	2000	Vdc
Screen Voltage	250	250	250	250	300	Vdc
Grid Voltage	-90	-90	-90	-90	-90	Vdc
Plate Current	250	250	250	250	250	mAdc
Screen Current 1	45	38	21	19	10	mAdc2
Grid Current 1	35	31	28	26	25	mAdc2
Peak rf Grid Voltage 1	114	114	112	112	---	v
Measured Driving Power 1	4.0	3.5	3.2	2.9	---	W
Plate Input Power	125	250	375	500	500	W
Plate Output Power	70	190	280	390	225	W 2
Heater Voltage	6.0	6.0	6.0	6.0	5.5	V

1. Approximate value.
2. Measured values for a typical cavity amplifier circuit.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION[1]	165	WATTS
SCREEN DISSIPATION[2]	12	WATTS
GRID DISSIPATION[2]	2	WATTS

1. Corresponds to 250 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 175 MHz)

Plate Voltage	500	1000	1500	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-100	-100	-100	Vdc
Plate Current	200	200	200	mAdc
Screen Current	31	22	20	mAdc
Grid Current	15	14	14	mAdc
Peak rf Grid Voltage	118	117	117	v
Calculated Driving Power	1.8	1.7	1.7	W
Plate Input Power	100	200	300	W
Plate Output Power	60	145	235	W

3. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB , Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate value.
2. Per Tube.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1/3]	-55	-55	-55	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max Signal Plate Current	500	500	500	mAdc
Max Signal Screen Current[1]	20	16	10	mAdc
Max Signal Grid Current[1]	0	0	0	mAdc
Peak af Grid Voltage[2]	50	50	50	v
Peak Driving Power	0	0	0	W
Plate Input Power	500	750	1000	W
Plate Output Power	240	430	600	W
Load Resistance (plate to plate)	3500	6200	9500	Ω

3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Nom.	Max.	
Heater: 4CX250B Current at 6.0 volts	2.3	---	2.9	A
Heater: 4CX250F Current at 26.5 volts	0.50	---	0.62	A
Cathode Warmup Time	30	60	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)				
Input	14.2	---	17.2	pF
Output	4.0	---	5.0	pF
Feedback	---	---	0.06	pF
Interelectrode Capacitances[1] (grounded grid and screen)				
Input	---	13.0	---	pF
Output	4.0	---	5.0	pF
Feedback	---	0.01	---	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CX250B and 4CX250F may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the EIMAC SK-600 series and an EIMAC SK-606 chimney are used with air flow in the base to anode direction.

SEA LEVEL			10,000 FEET	
Plate Dissipation(watts)	Air Flow (CFM)	Pressure Drop(In.of water)	Air Flow (CFM)	Pressure Drop(In.of water)
200	5.0	0.52	7.3	0.76
250	6.4	0.82	9.3	1 20

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 MHz or below, base cooling air requirements are satisfied automatically when the tube is operated in an EIMAC Air-System Socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

VIBRATION - These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration more severe than this are expected, it is suggested that the EIMAC 4CX300A or 4CX250R be employed.

ELECTRICAL

HEATER - The rated heater voltage for the 4CX250B and 4CX250F is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ± 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the table below;

Frequency MHz	4CX250B	4CX250F
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.3 volts
401 to 500	5.50 volts	24.3 volts

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 mA for plate-modulated operation and 250 mA for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving-power requirements for

amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approximately 15 mA.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an a equate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers usin g these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4CX250B or 4CX250F.

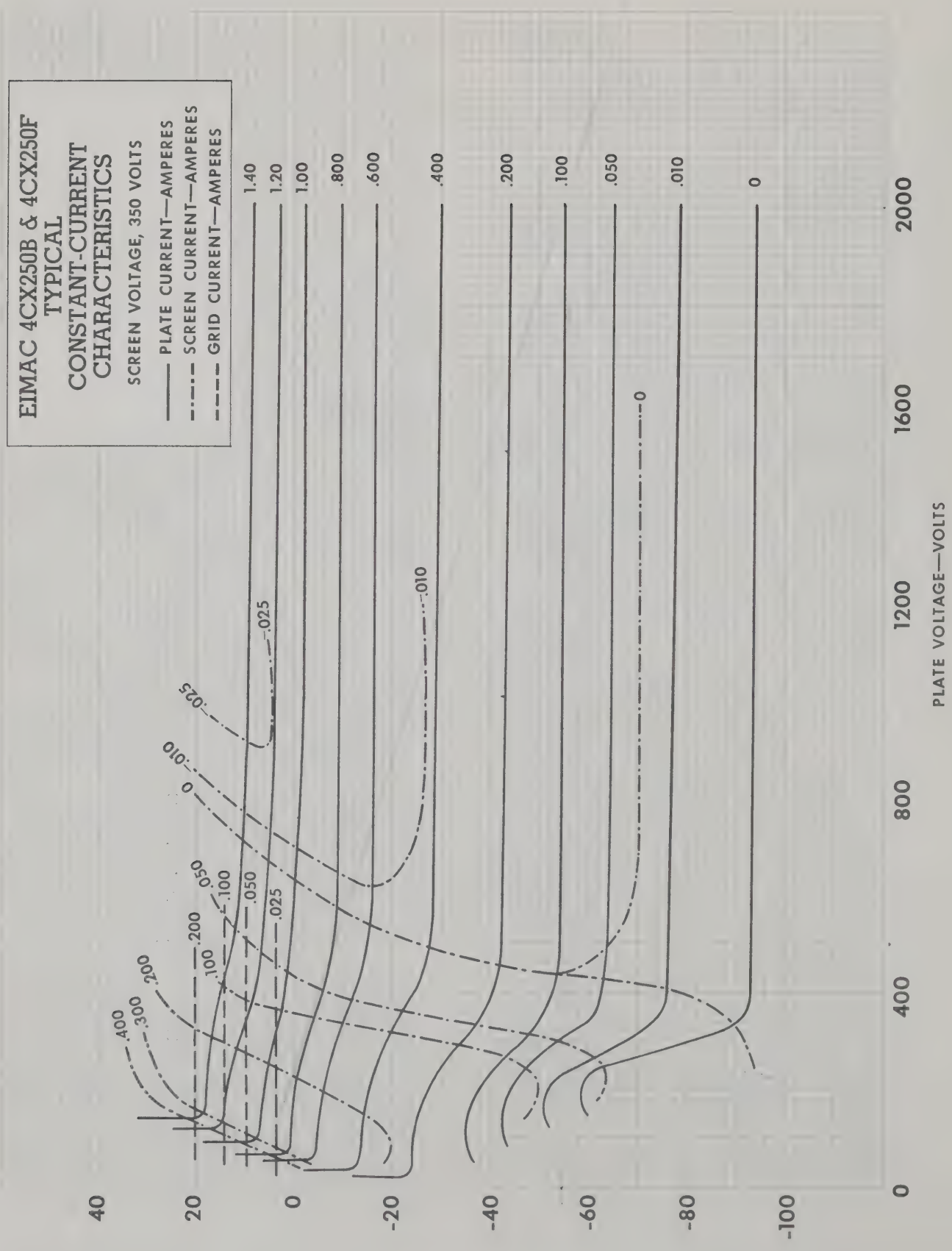
PLATE OPERATION - The maximum rated plate dissipation power is 250 watts. In plate-modulated applications the carrier plate dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

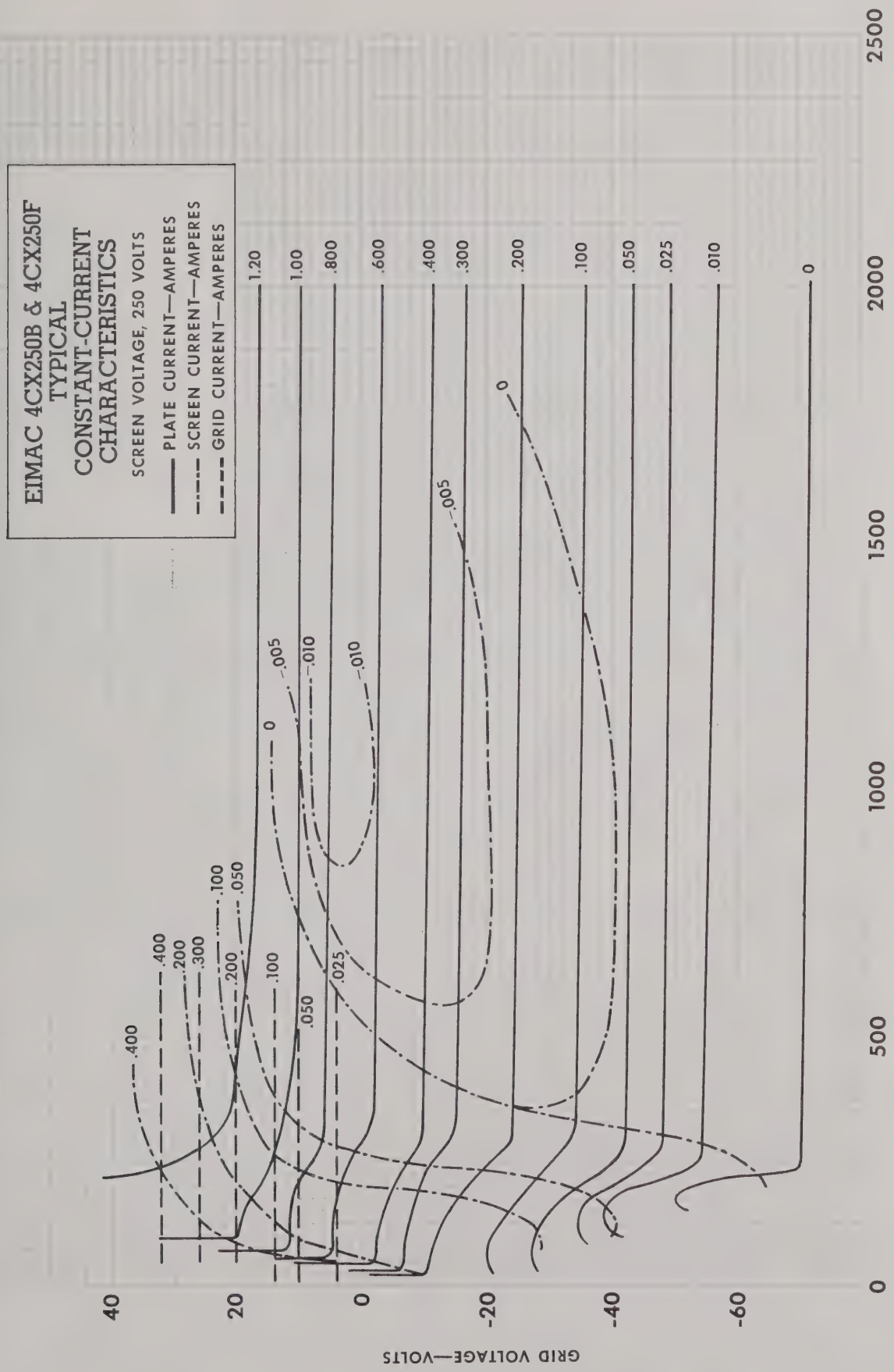
MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

VHF OPERATION - The 4CX250B and 4CX250F are suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

SPECIAL APPLICATIONS-If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Dept., EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.


EIMAC 4CX250B & 4CX250F
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.025
.050
.100
.200
.300
.400
GRID VOLTAGE—VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
PLATE VOLTAGE—VOLTS

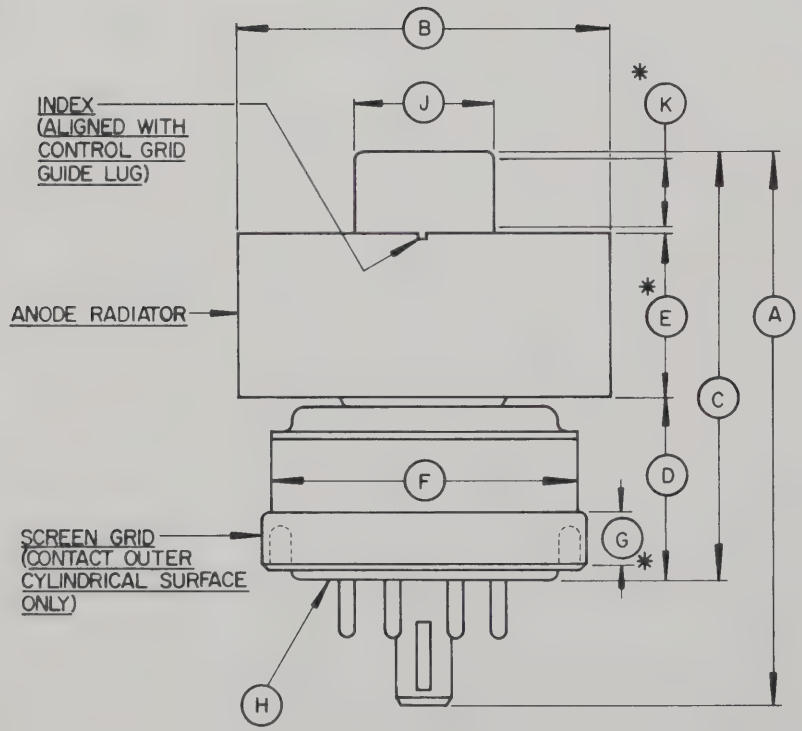

EIMAC 4CX250B & 4CX250F
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
0
500
1000
1500
2000
2500
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
.400
.200
.300
.100
.050
.200
.100
.050
.025
.010
.005
0

PIN DESIGNATION

PIN NO. 1	SCREEN GRID
PIN NO. 2	CATHODE
PIN NO. 3	HEATER
PIN NO. 4	CATHODE
PIN NO. 5	I.C. DO NOT USE FOR EXTERNAL CONNECTION.
PIN NO. 6	CATHODE
PIN NO. 7	HEATER
PIN NO. 8	CATHODE

CENTER PIN-CONTROL GRID

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	2.342	2.464	59.03	62.59
B	1.610	1.640	40.89	41.66
C	1.810	1.910	45.97	48.51
D	0.750	0.810	19.05	20.57
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE: B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55
K	0.240	--	6.10	--



NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES.

EIMAC

EITEL-McCULLOUGH, INC.

4CX250R

RADIAL-BEAM POWER TETRODE

The 4CX250R is a compact, high-perveance radial-beam tetrode designed specifically for use in class-AB_1 linear amplifiers where shock and/or vibration preclude the use of non-ruggedized tube types. The 4CX250R will replace the 7580 in almost all applications since it is electrically identical except for a minute (0.2 uuf) increase in output-capacitance limits. Further, it will replace the 4X250B or 4CX250B in equipments where the range of bias adjustment will tolerate this higher perveance tube and where tuning range can compensate for the small differences in input and output capacitances.

The 4CX250R will deliver more output power in most linear amplifiers which presently employ the 4X250B or 4CX250B and it will operate with maximum rated plate and screen voltages applied in equipments where shock and/or vibration is experienced. See **Shock and Vibration** section on page two for details.



GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-Coated, Unipotential				
	Heating Time	30	60		seconds
	Cathode-to-Heater Potential	—		±150	volts
Heater:	Voltage		6.0		volts
	Current	2.3		2.9	amperes
Direct Interelectrode Capacitances, Grounded Cathode:					
	Input	16.0		18.5	uuf
	Output	4.2		5.2	uuf
	Grid-to-Plate			0.06	uuf
Frequency for Maximum Ratings				500	Mc

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Recommended Socket	Eimac SK-600 Series
Operating Position	Any
Maximum Dimensions:	
Height	2.464 inches
Seated Height	1.910 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 - Single Sideband

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS

TYPICAL OPERATION

Two-Tone where peak envelope power is at least twice the average power output—Actual measurements—Tank-circuit efficiency estimated at 95%.

D-C Plate Voltage	1500	2000	volts
Zero-Signal D-C Plate Current	133	070	ma
Two-Tone D-C Plate Current	250	245	ma
D-C Screen Voltage	350	400	volts
Two-Tone D-C Screen Current	—10	+1	ma
D-C Grid-Bias Voltage	—62	—80	volts
Peak Signal Voltage	56	80	volts
3rd Order Intermodulation products referred to signal level	—30	—23	db
5th Order Intermodulation products referred to signal level	—35	—27	db
Worst 3rd Order Intermodulation as drive signal is reduced	—29	—21	db
Load Resistance	2160	2840	ohms
Peak Envelope Power	262	470	watts

(Effective 6-16-61) Copyright 1961 by Eitel-McCullough, Inc.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier with Double Sidebands)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS

TYPICAL OPERATION—Single Tube

(Quantities shown for carrier conditions, no modulation)

D-C Plate Voltage	1500	2000	volts
D-C Plate Current	172	172	ma
D-C Screen Voltage	350	400	volts
D-C Screen Current (Approx)	—3	—5	ma
D-C Grid-Bias Voltage	—58	—76	volts
Peak Grid-Signal Voltage	30	39	volts
Plate-Load Resistance	2320	3150	ohms
Power Output for Tank Circuit Efficiency of 95%	55	100	watts

AUDIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS

TYPICAL OPERATION (Two Tubes Push-Pull)

D-C Plate Voltage	1500	2000	volts
D-C Plate Current No Signal	200	140	ma
D-C Plate Current at Full Signal	490	500	ma
D-C Screen Voltage	300	350	volts
D-C Screen Current No Signal	—2	—4	ma
D-C Screen Current at Full Signal	0	+4	ma
D-C Grid-Bias Voltage (Approx)	—48	—66	volts
Plate-to-Plate Load Resistance	5920	8016	ohms
Power Output for Transformer Efficiency of 95%	390	595	watts

MAXIMUM RATINGS FOR OTHER TYPES OF OPERATION

Class-C Telegraphy or FM

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

Class-C, Plate Modulated

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

APPLICATION

MECHANICAL

Mounting—The 4CX250R may be mounted in any position. An Eimac Air-System Socket of the SK-600 series or equivalent is recommended. These sockets may be obtained with or without the r-f screen by-pass capacitor, and with or without the four cathode terminals grounded to the socket shell. A simple Lock-in socket restricts the flow of cooling air and is not recommended.

Cooling—The 4CX250R has an efficient louvered anode cooler. The maximum allowable temperature for any external surface is 250°C.

For long service life at sea level, at an ambient temperature of 25°C and maximum rated anode dissipation of 250 watts, a *minimum* of 4.6 cfm air should flow from tube base through the anode cooler. The corresponding pressure drop with the recommended socket and chimney will be approximately 0.32 inch water column. See table for other dissipation levels and conditions.

4.6 cfm of air at 25°C is the same as a mass air flow of 18 pounds per hour. Higher ambient temperature requires greater air mass and volume. Higher altitude requires equivalent mass air flow for a given ambient temperature and therefore requires greater volume at increased back pressure.

The use of temperature-sensitive laquer is recommended to determine the effectiveness of a cooling system under operating conditions.

Plate Dissipation (Watts)	55°C AMBIENT			
	SEA LEVEL		10,000 FEET ALTITUDE	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
75	1.15	0.025	1.8	0.036
125	2.3	0.09	3.35	0.13
250	6.4	0.59	9.3	0.86

Shock and Vibration—The 4CX250R is one of the Eimac tube types which is unique in that shock and vibration testing is performed with *maximum rated plate and screen voltages* applied. Two samples of production tubes are randomly selected periodically and tested under the conditions outlined below.

With *maximum rated plate and screen voltages* applied, each of the tubes in this sample is subjected to six shocks of 90 G (minimum) half-sine-wave motion, with a duration of 11±2 milliseconds, in each of the three major axes (X1, X2, and Y1).

With *maximum rated plate and screen voltages* applied and with control-grid voltage adjusted to allow the flow of 100 ma through a plate load resistor of 4900 ohms, each of the tubes in this sample is vibrated in the three major axes throughout the range of 5-750-5 cps in a minimum time of six minutes per axis. The vibration level is maintained at 10 G from 28 cps to 750 cps and at 0.25 inch D.A. from 5 cps to 28 cps. During this test, noise voltage developed across the plate load resistor cannot exceed 30 volts rms. Sufficient plate power-supply voltage (2500 volts) is em-

ployed to assure that a minimum of 2000 volts appears at the plate of the tube under test even though 490 volts drop across the plate load resistor results from d-c plate-current flow.

The equipment designer is cautioned to provide adequate tube support to prevent relative motion between tube and socket in equipments where shock and/or vibration are anticipated.

ELECTRICAL

Heater—For maximum life and uniform performance, the heater voltage should be maintained within plus or minus 5% of the rated 6.0 volts at operating frequencies up to 300 Mc. For CW use between 300 and 400 Mc, 5.75 volts is recommended. For CW use, 400 to 500 Mc, 5.5 volts is recommended.

Cathode—The cathode is connected to the four even-numbered base pins to provide a low-inductance path, or permit separation of input and output circuits if required.

Rated heater voltage should be applied for 30 seconds before other operating voltages are applied.

Heater-to-cathode maximum voltage is ±150 volts.

Control Grid—Maximum rated d-c bias voltage is −250 volts. D-C resistance, grid to cathode, should be no more than 100,000 ohms.

Screen Grid—Maximum screen dissipation is 12 watts, normally computed by multiplying d-c screen voltage by the average screen current. This computation is essentially correct except in the case of heavy plate loading when secondary-emission current may mask the normal screen current.

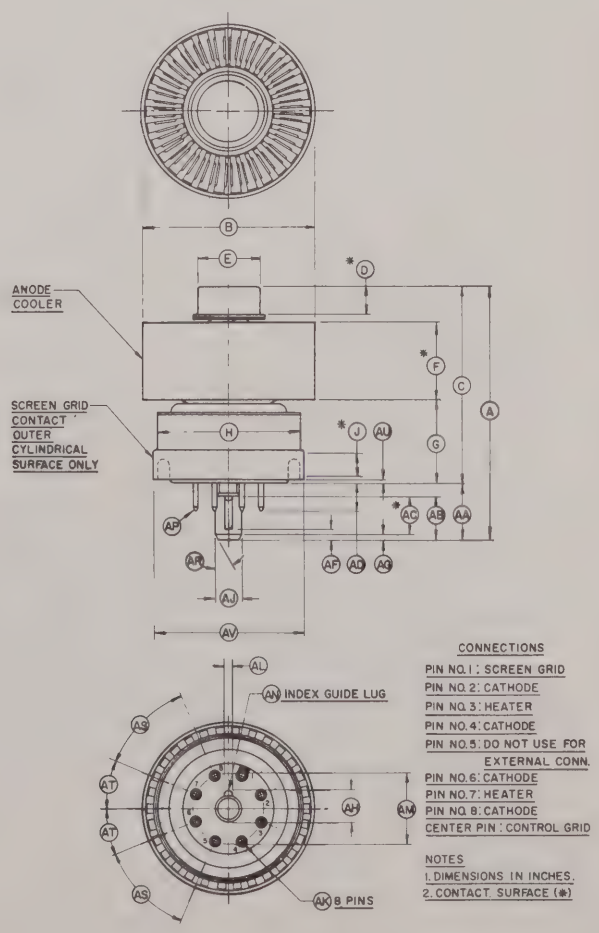
All tetrodes, under some conditions of loading and drive, will exhibit secondary emission from the screen which changes the net current to the screen and may even cause the screen meter to reverse. Normally, secondary emission is harmless provided the screen voltage is stable. To insure stable screen voltage, it is recommended that a bleeder resistor calculated to pass 15 ma from screen to ground be used.

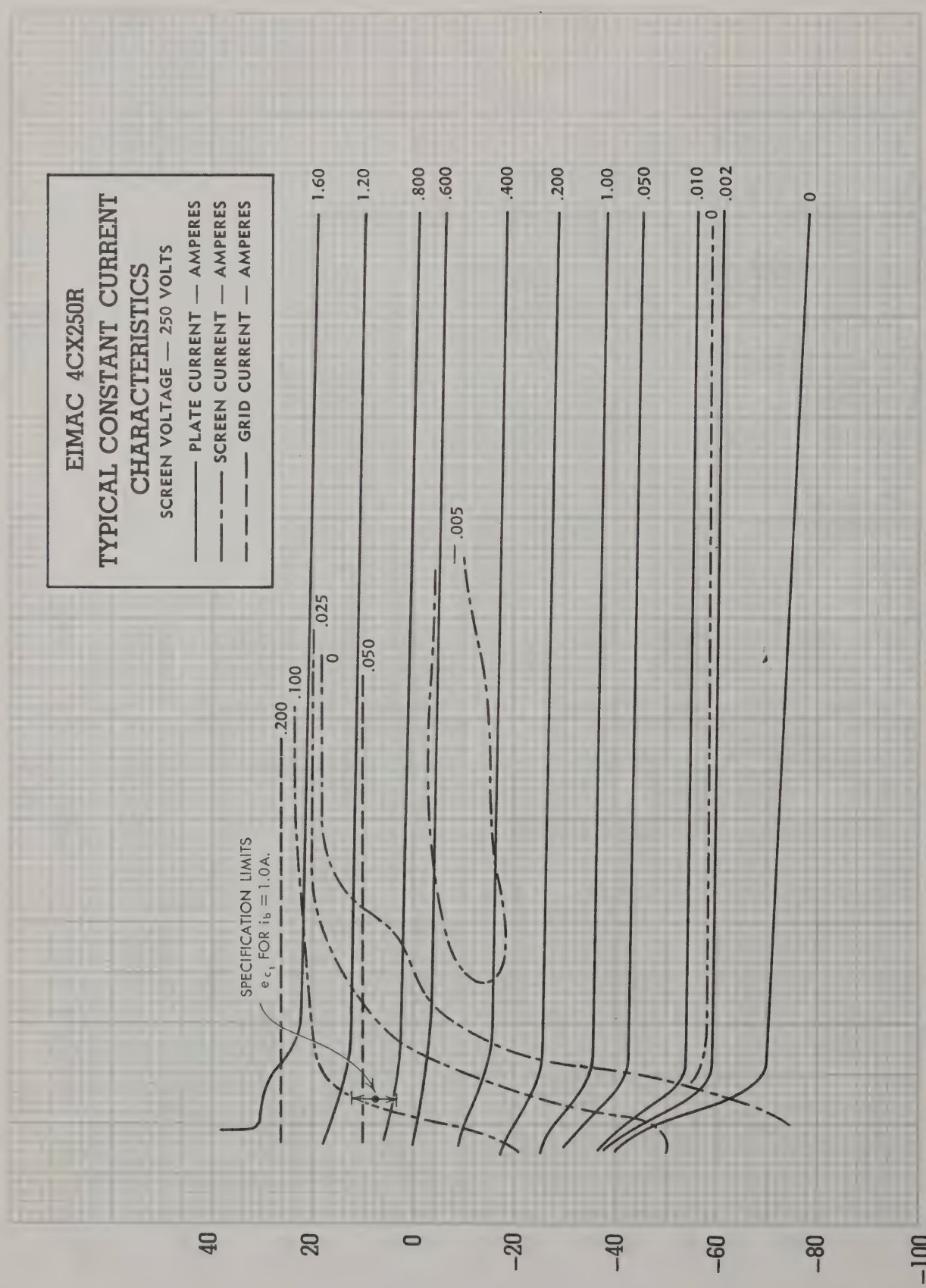
Plate Dissipation—The maximum plate dissipation is 250 watts. The usual single-sideband voice signal is complex and full peak envelope power shown in Typical Operating Conditions, may be developed without exceeding this plate dissipation. Single-tone testing for short periods with greater than 250 watts plate dissipation is permissible.

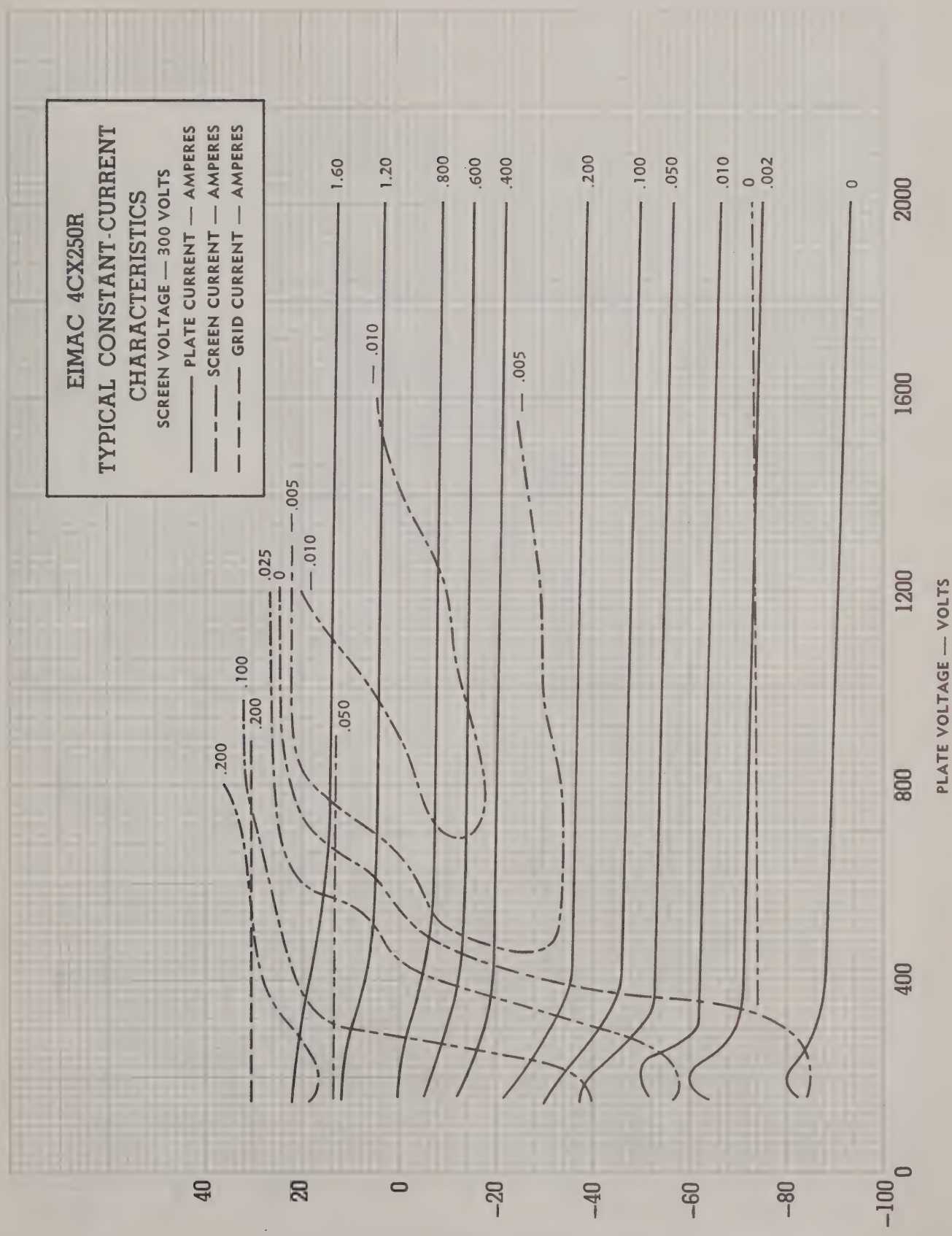
Multiple Operation — To obtain maximum power with minimum distortion from tubes operated in multiple it is desirable to adjust individual screen or grid-bias voltages so the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual d-c plate currents will be approximately equal for full input signal for class-AB_1 operation.

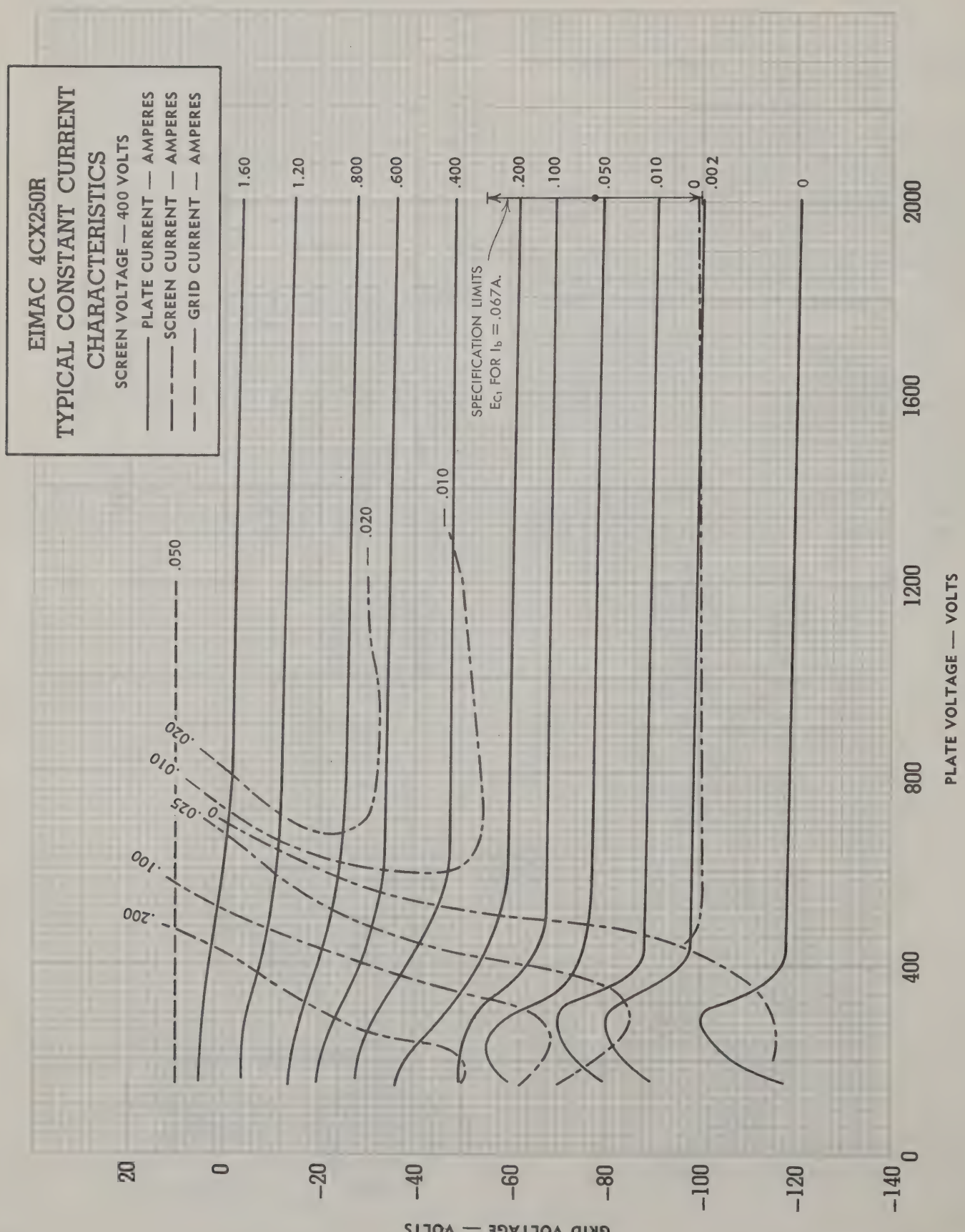
Special Application—If it is desired to use the 4CX250R under conditions widely different from those given here, consult the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., San Carlos, California, or any of our regional offices or representatives.

DIMENSION DATA		
REF.	MIN.	MAX.
A	2.324	2.464
B	1.610 DIA.	1.640 DIA.
C	1.810	1.910
D	.240	.280
E	.559 DIA.	.573 DIA.
F	.710	.790
G	.750	.810
H		1.406 DIA.
J	.187	
AA	.514	.554
AB		.456
AC	.360	
AD		.250
AF	.068	.108
AG	.031 NOM.	
AH	.298	.308
AJ	.255 DIA.	.265 DIA.
AK	.045 DIA.	.053 DIA.
AL	.078	.086
AM	.680 DIA.	.694 DIA.
AN		.043 R.
AP	.005 R. MIN. OR	
	.035 X 22.5°	
AR	30° NOM.	
AS	45° NOM.	
AT	22.5° NOM.	
AU	.080 NOM.	
AV	1.417 DIA.	1.433 DIA.




EIMAC 4CX250R
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
SPECIFICATION LIMITS
e_{c_1} FOR i_b = 1.0A.
1.60
1.20
.800
.600
.400
.200
1.00
.050
.010
.002
0
.005
.050
.025
.100
.200
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS


EIMAC 4CX250R
TYPICAL CONSTANT-CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 300 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
1.60
1.20
.800
.600
.400
.200
.100
.050
.010
0
.002
.200
.100
.200
.050
.025
0
.010
.005
.010
.005
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS



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Division of Varian
SAN CARLOS
CALIFORNIA

SK-810B
AIR-SYSTEM SOCKET GROUNDED CATHODE TERMINALS
SK-806
AIR CHIMNEY

The EIMAC SK-810B is one of the air-system sockets recommended for use with the EIMAC 4CX1000A or 4CW2000A tetrodes. A companion SK-806 Air Chimney is also available and is recommended for use with the socket when the air-cooled 4CX1000A is to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor. The SK-810B is humidity and salt-spray resistant.

The SK-810B is an improved version of the SK-810 and directly replaces the SK-810 in any equipment. The SK-810B features a stronger, one-piece base and improved contact tabs.



SK-810B

8255

BASE CONNECTIONS

The SK-810B socket consists of three sets of spring-finger contact tabs for each tube electrode (to assure low-inductance contact), a center guide pin to facilitate tube installation, and an integral screen by-pass capacitor. The terminals are shown on the outline drawing.

When this socket is mounted on a grounded chassis, the cathode and one side of the heater will be automatically grounded. A grounding terminal is provided and may be used for positive connection if desired.

SCREEN GRID BY-PASS CAPACITOR

This capacitor utilizes Mylar film as a dielectric and is encapsulated in silicone resin. Its capacitance is 1500 pF ±20 percent and it is rated at 400 dc working volts. One side connects to the three screen-grid tabs on the tube and the other side is connected directly to the socket body.



SK-810B WITH CHIMNEY

MATERIALS AND FINISHES

The metal shell, or body, of the socket is fabricated of silver-plated brass, while the mounting base and centering pin are a one-piece, nickel-plated die casting. All contacts are formed on a non-ferrous alloy, heat-treated and silver-plated. Contact insulating material is high-temperature ceramic.

INSTALLATION

The SK-810B Air-System Socket is designed for under-chassis mounting and requires a 5-1/16 inch hole through the chassis deck. The socket is held in place by the three toe clamps provided. One side of the screen-grid by-pass capacitor is automatically grounded to the chassis when this mounting method is used.

AIR CHIMNEY

The SK-806 Air Chimney is molded of fiberglass-reinforced silicone resin. It effectively directs the flow of air to the anode cooling fins with minimum pressure drop and is recommended for use with each SK-810B when the air-cooled 4CX1000A is to be socketed.

SK-810B

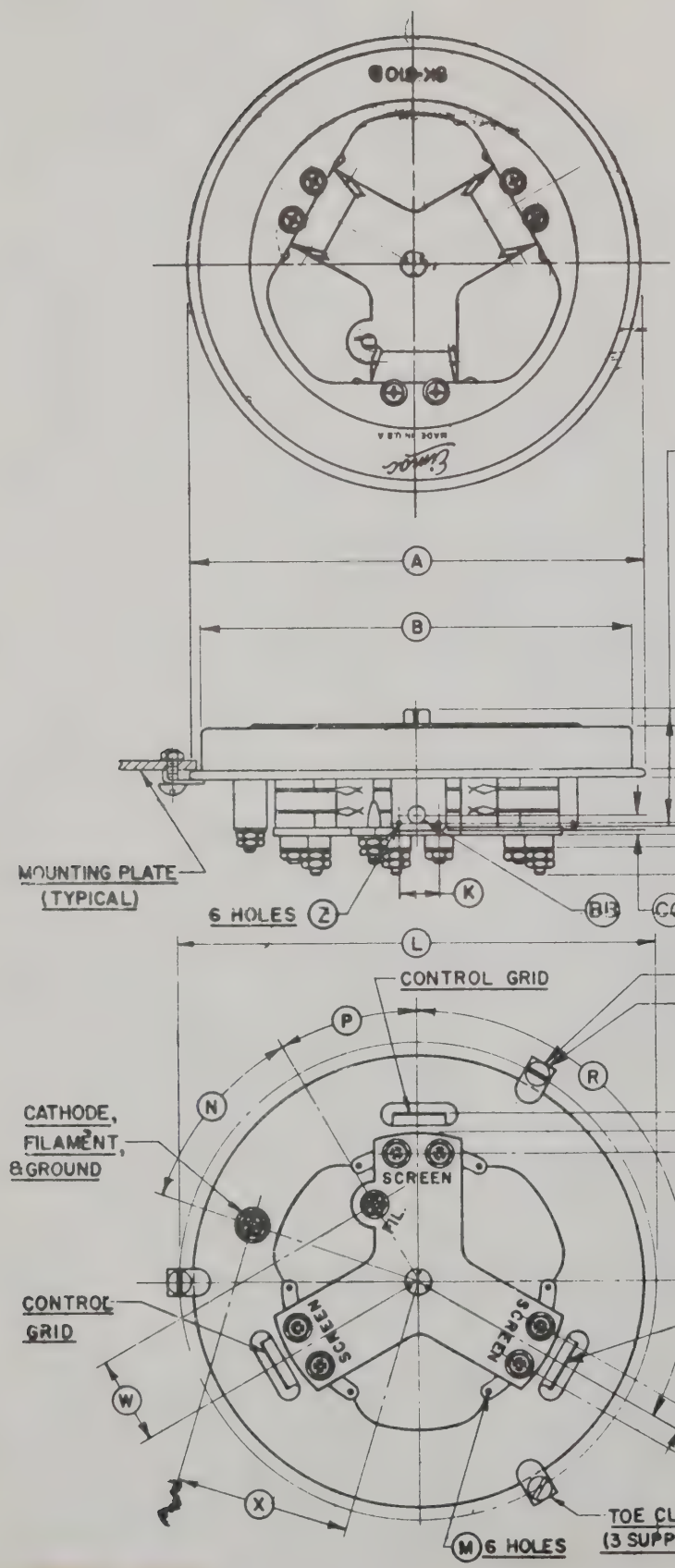
Net Weight	18 ounces

SK-806

Net Weight	3-¼ ounces
Maximum Height	1-⅜ inches
Maximum Diameter	6-⅜ inches

(Revised 6-1-67) © 1964, 1967 by Varian

Printed in U.S.A.



DIMENSION DATA			
DIM.	MIN.	MAX.	REF.
A	5.290	5.330	
B	5.010	5.047	
C	.690	.730	
D	1.100	1.170	
E			.760
F	.641	.681	
G	.500	.540	
H	.110	.140	
J	.510	.540	
K	.422	.452	
L			5.595
M	.057 DIA.	.077 DIA.	
N	40°	42°	
P	29°	31°	
R	119°	121°	
S	1.490	1.530	
T	1.699	1.739	
U	1.917	1.957	
V	.245	.255	
W	1.052	1.072	
X	2.052	2.072	
Y	.142 DIA.		
Z	.078 DIA.	.108 DIA.	
AA	1.246	1.286	
BB	.156 DIA.	.186 DIA.	
CC			.234
DD	.125R	.187R	
EE	.292	.332	
FF	.292	.332	
GG	.105	.145	
HH		.062R	
JJ	80°	100°	
KK	.417	.457	
LL	.142	.146	

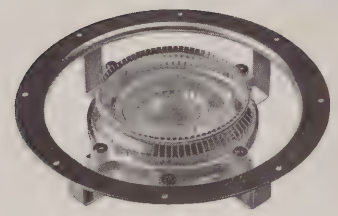
NOTES

1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES.
3. CAPACITANCE 1500MMFD ± 20%
VOLTAGE 1000VDC TEST, 400WVDC
INSULATED TO WITHSTAND HUMIDITY & SALT SPRAY MIL STD-202B.

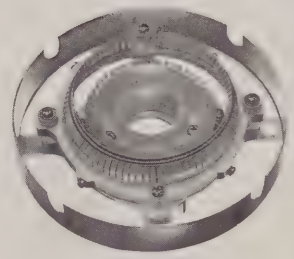
SK-1300
SK-1310
SK-1320

AIR-SYSTEM SOCKETS

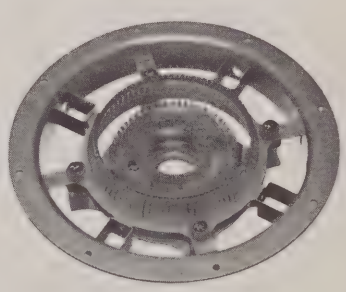
These sockets have been designed for use with the tube types listed below. The SK-1300 and the SK-1320 are intended for mounting on a pressurized chassis or plenum, allowing air-cooling of the tube base and terminals.



SK-1300



SK-1310



SK-1320

BASE CONNECTIONS

All these sockets are provided with three concentric rings of spring contact fingers for making contact to the filament and the grid of the coaxial triodes listed below.

The filament contact fingers are terminated on two bus connections to insure good high frequency current distribution. Each of these two bus rings is provided with two lugs for making external connections.

The grid spring-finger contacts are terminated on a heavy support assembly. The grid contact assembly is insulated from the socket mounting cup in the SK-1300; it is grounded to the cup in the SK-1320, for grounded-grid operation. The SK-1310 is a version intended for use with vapor-cooled versions of these coaxial triodes and has no grounded contacts.

MATERIALS AND FINISHES

The contact fingers are non-ferrous spring alloy, heat-treated for positive spring action and silver-plated for good rf conductivity. The main socket body and cup assemblies are made of brass and are also silver plated.

INSTALLATION

The SK-1300 and SK-1320 are supported by the socket cup on a pressurized compartment or chassis. A 7-1/8 inch diameter hole is required in the supporting chassis or plenum and the socket is secured by eight #6 machine screws on a 7-3/4 inch pitch circle. The socket cup on both these sockets is open so that air may be directed through them for cooling of the tube base terminals.

The SK-1310, which is designed for use on vapor-cooled versions of these tubes, has no mounting/support cup; it is held into place on the base of the tube only by its contact finger assemblies for the grid and filament.

(Revised 3-1-72) © 1963, 1966, 1972 Varian Printed in U.S.A.

CHIMNEY

A companion Air-Chimney, the SK-1306, is available for use with the SK-1300 and SK-1320 and some of the air-cooled triode types, as listed below. The chimney is mounted above the chassis deck and is installed using the same eight mounting screws used for securing the socket to the chassis or deck.

Use of an Air-Chimney allows simplified cooling of the tube; air forced through the socket is directed through the chimney and then through the tube's anode cooling fins.

SOCKET/CHIMNEY/TUBE TYPE GUIDE

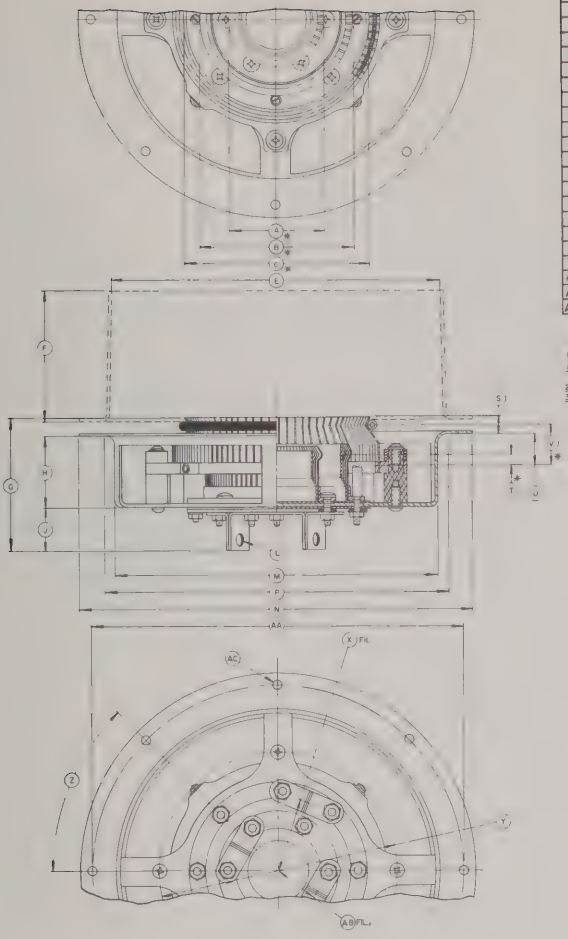
SOCKET	TUBE TYPE NUMBER	RECOMMENDED AIR CHIMNEY
SK-1300 and SK-1320	3CW10,000A3	none - water cooled tube
	3CW20,000A1	none - water cooled tube
	3CW20,000A3	none - water cooled tube
	3CW20,000A7	none - water cooled tube
	3CW25,000A3	none - water cooled tube
	3CX5000A3	special - EIMAC Y-463
	3CX10,000A1/8158	SK-1306
	3CX10,000A3/8159	SK-1306
	3CX10,000A7/8160	SK-1306
	3CX15,000A3	SK-1306
	3CX20,000A3	none available
SK-1310	3CV30,000A1	none - vapor cooled tube
	3CV30,000A3	none - vapor cooled tube

NET WEIGHTS

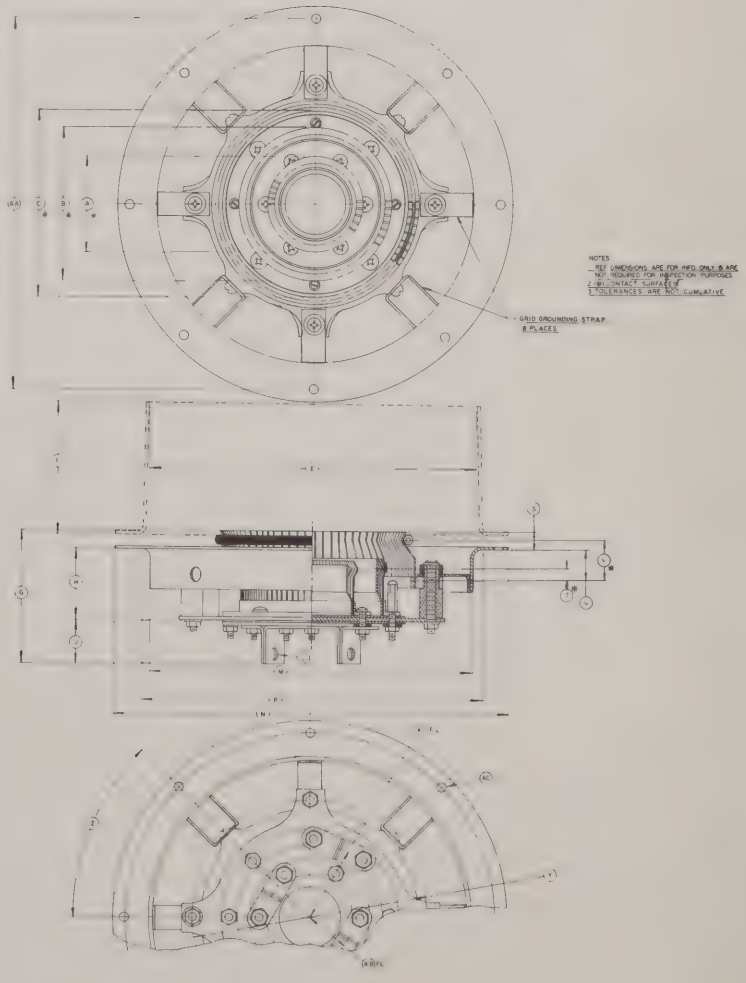
SK-1300, SK-1310, SK-1320 ..... 2.3 lbs; 1.04 kg

DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN	MAX	REF	MIN.	MAX	REF
A	1.990	2.070	- -	50.55	52.58	- -
B	3.240	3.320	- -	82.30	84.33	- -
C	3.700	3.770	- -	93.98	95.76	- -
E	7.030	7.125	- -	178.56	180.97	- -
F	3.590	3.690	- -	91.19	93.73	- -
G	2.710	2.835	- -	68.83	72.01	- -
H	1.440	1.530	- -	36.58	38.86	- -
J	0.890	0.960	- -	22.61	24.38	- -
L	0.235	0.265	- -	5.97	6.73	- -
M	6.720	6.780	- -	170.69	172.21	- -
N	8.220	8.280	- -	208.79	210.31	- -
P	7.060	7.190	- -	179.32	182.63	- -
S	0.270	0.395	- -	6.86	10.03	- -
T	0.185	0.285	- -	4.70	7.24	- -
U	0.580	0.700	- -	14.73	17.78	- -
V	0.760	0.865	- -	19.30	21.97	- -
X	1.500	1.620	- -	38.10	41.15	- -
Y	4.970	5.030	- -	126.24	127.76	- -
Z	43°	47°	- -	43°	47°	- -
AA	7.730	7.770	- -	196.34	197.36	- -
AB	0.860	0.980	- -	21.84	24.89	- -
AC	0.140	0.154	- -	3.56	3.91	- -

NOTES
1. REF DIMS ARE FOR INFO ONLY AND ARE NOT REQD FOR INSP PURPOSES.
2. (⊕) CONTACT SURFACES.
3. TOLERANCES ARE NOT CUMULATIVE.



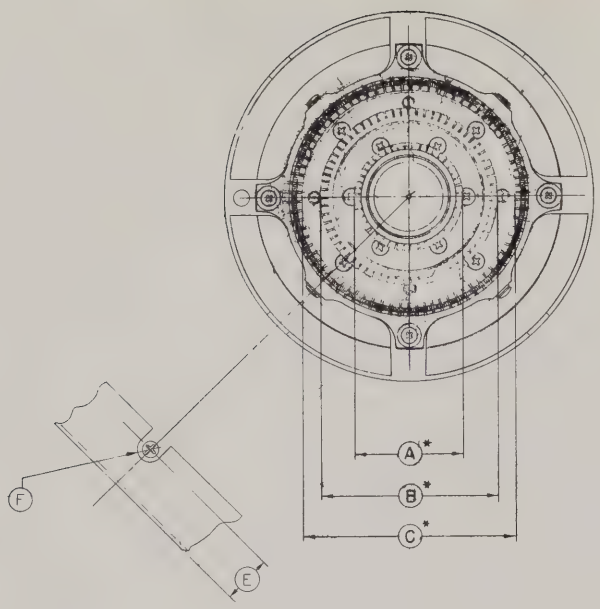
SK-1300



NOTES
1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES
2. (⊕) CONTACT SURFACES
3. TOLERANCES ARE NOT CUMULATIVE

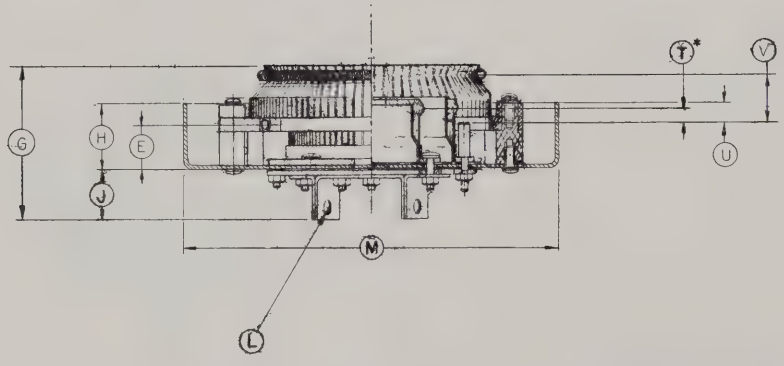
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	1.990	2.070	- -	50.55	52.58	- -
B	3.240	3.320	- -	82.30	84.33	- -
C	3.700	3.770	- -	93.98	95.76	- -
E	7.030	7.125	- -	178.56	180.97	- -
F	3.590	3.690	- -	91.19	93.73	- -
G	2.710	2.835	- -	68.83	72.01	- -
H	1.440	1.530	- -	36.58	38.86	- -
J	0.890	0.960	- -	22.61	24.38	- -
L	0.235	0.265	- -	5.97	6.73	- -
M	6.720	6.780	- -	170.69	172.21	- -
N	8.220	8.280	- -	208.79	210.31	- -
P	7.060	7.190	- -	179.32	182.63	- -
S	0.270	0.395	- -	6.86	10.03	- -
T	0.185	0.285	- -	4.70	7.24	- -
U	0.580	0.700	- -	14.73	17.78	- -
V	0.760	0.865	- -	19.30	21.97	- -
X	1.500	1.620	- -	38.10	41.15	- -
Y	4.970	5.030	- -	126.24	127.76	- -
Z	43°	47°	- -	43°	47°	- -
AA	7.730	7.770	- -	196.34	197.36	- -
AB	0.860	0.980	- -	21.84	24.89	- -
AC	0.140	0.154	- -	3.56	3.91	- -

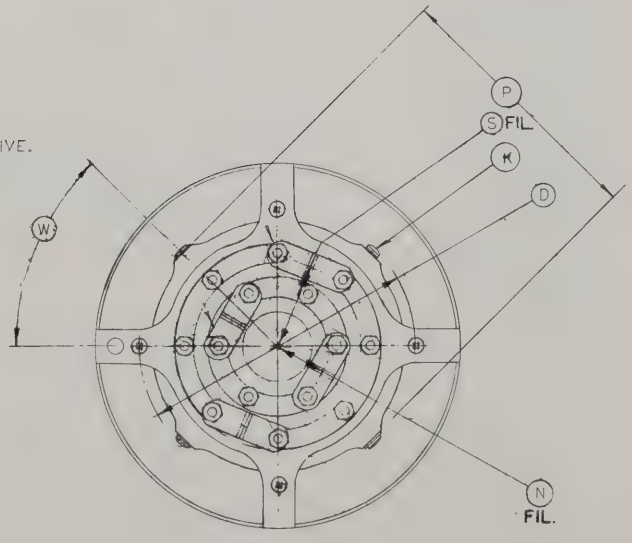
SK-1320



DIM.	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MAX	MIN.	REF	MIN.	MAX.	REF
A	2.061	2.001	- -	50.82	52.35	- -
B	3.311	3.251	- -	82.57	84.10	- -
C	3.732	3.672	- -	93.27	94.79	- -
D	5.030	4.970	- -	126.24	127.76	- -
E	0.890	0.860	- -	21.84	22.61	- -
F	0.267	0.233	- -	5.92	6.78	- -
G	2.835	2.710	- -	68.83	72.01	- -
H	1.187	1.156	- -	29.36	30.15	- -
J	0.960	0.890	- -	22.61	24.38	- -
K	6-32 NC					
L	1/4 DIA HOLE			6.35 DIA HOLE		
M	6.780	6.720	- -	170.69	172.21	- -
N	0.980	0.860	- -	21.84	24.89	- -
P	4.690	4.620	- -	117.35	119.13	- -
S	1.620	1.500	- -	38.10	41.15	- -
T	0.285	0.185	- -	4.70	7.24	- -
U	0.314	0.280	- -	7.11	7.97	- -
V	0.856	0.826	- -	20.98	21.74	- -
W	47°	43°	- -	43°	47°	- -

SK-1310





NOTES:
1. ALL DIMENSIONS ARE IN INCHES.
2. TOLERANCES ARE NOT CUMULATIVE.
*3. CONTACT SURFACES.

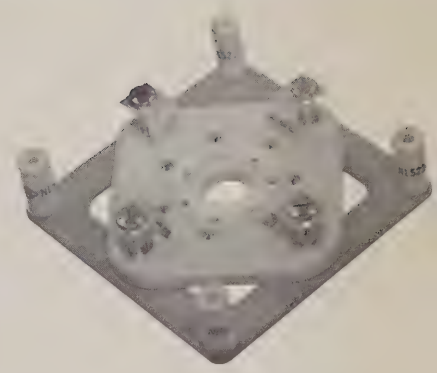
TECHNICAL DATA

SK-2200
SK-2210
AIR SYSTEM SOCKET

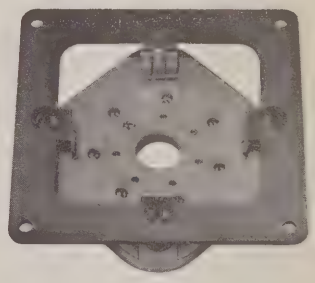
The EIMAC SK-2200 and SK-2210 are air-system sockets recommended for use with the EIMAC 8877/3CX1500A7 triode. Two companion chimneys are available, either of which will operate with either socket.

With these sockets, connection is made to each tube element except the anode.

No contacts are grounded on the SK-2200, while the SK-2210 has the grid contacts grounded to the equipment chassis when installed.



SK-2200



SK-2210

INSTALLATION

The SK-2200 and SK-2210 are designed for under-chassis mounting, and require a 3¼ inch hole through the chassis deck. Each socket is held in place by four 6-32 screws.

AIR CHIMNEYS

Two chimneys are available. The SK-2206 is made of fiber glass and is recommended for general purpose use at low and medium frequencies. For high frequency applications where losses must be held to a minimum, the SK-2216 chimney should be used as it is made of low-loss teflon. The SK-2206 is held in place with four clips (supplied with the chimney). The SK-2216 is held in place with four toe clamps (supplied with the chimney).



SK-2206



SK-2216

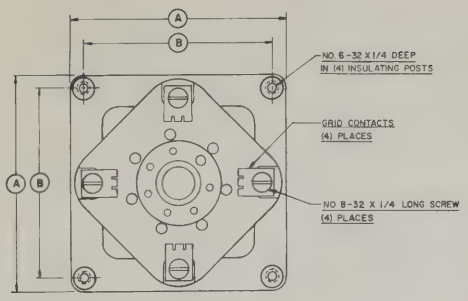
NET WEIGHTS

SK-2200 Socket	4.5 oz; 128 gm
SK-2210 Socket	4.0 oz; 113 gm
SK-2206 Chimney	1.5 oz; 42.5 gm
SK-2216 Chimney	2.0 oz; 56.7 gm

(Effective 8-15-71) © by Varian

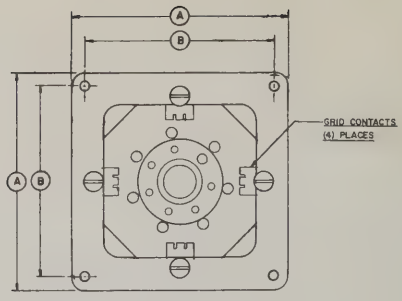
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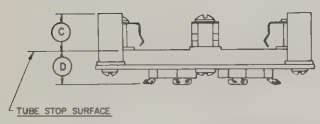
SK-2200/SK-2210

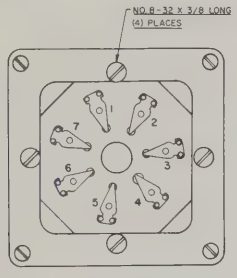


DIM	INCHES MIN	INCHES MAX	INCHES REF	MILLIMETERS MIN	MILLIMETERS MAX	MILLIMETERS REF
A	3.373	3.413	- -	85.67	86.70	- -
B	2.963	2.983	- -	75.01	75.77	- -
C	0.500	0.550	- -	12.70	13.97	- -
D	- -	.0630	- -	- -	16.00	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. CONNECTIONS:
   1-HEATER
   2-CATHODE
   3-CATHODE
   4-CATHODE
   5-HEATER
   6-CATHODE
   7-CATHODE
3. GRID CONTACTS INSULATED FROM GROUND & OTHER ELEMENTS.



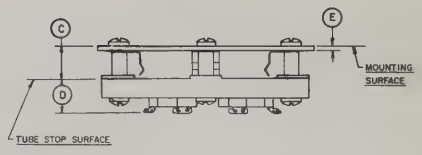


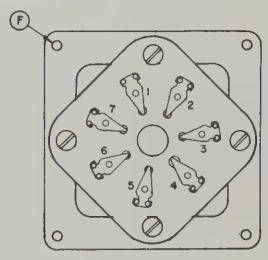


SK-2200 Socket

DIM.	INCHES MIN	INCHES MAX	INCHES REF	MILLIMETERS MIN	MILLIMETERS MAX	MILLIMETERS REF
A	3.373	3.413	- -	85.67	86.70	- -
B	2.953	2.983	- -	75.01	75.77	- -
C	0.474	0.553	- -	12.04	14.05	- -
D	- -	0.630	- -	- -	16.00	- -
E	- -	- -	0.063	- -	- -	1.60
F	0.140	0.149	- -	3.56	3.78	- -

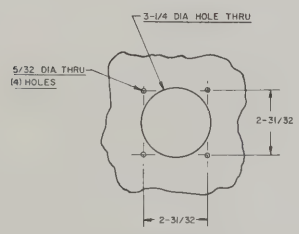
NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. CONNECTIONS:
   1-HEATER
   2-CATHODE
   3-CATHODE
   4-CATHODE
   5-HEATER
   6-CATHODE
   7-CATHODE
3. GRID CONTACTS GROUNDED TO MOUNTING PLATE.





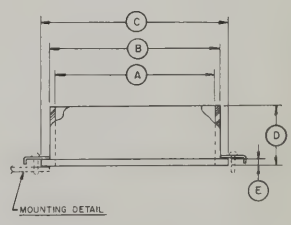
SK-2210 Socket

Typical Chassis Cut out

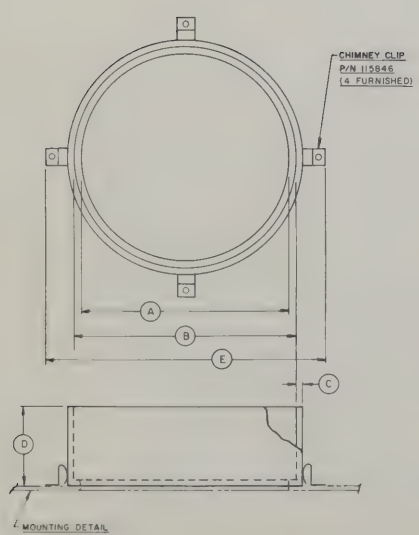


CHASSIS CUT OUT FOR MOUNTING & REQUIRED COOLING AIR FLOW.

DIM	INCHES MIN	INCHES MAX	INCHES REF	MILLIMETERS MIN	MILLIMETERS MAX	MILLIMETERS REF
A	3.385	3.415	- -	85.98	86.74	- -
B	3.532	3.592	- -	89.71	91.24	- -
C	3.907	3.967	- -	99.24	100.76	- -
D	.220	.280	- -	30.99	32.51	- -
E	0.10	0.40	- -	2.79	3.56	- -
F	0.417	0.457	- -	10.59	1.61	- -
G	0.292	0.332	- -	7.42	8.43	- -
H	0.292	0.332	- -	7.42	8.43	- -
J	0.105	0.145	- -	2.67	3.68	- -
K	80°	100°	- -	80°	100°	- -
L	0.142	0.146	- -	3.61	3.71	- -

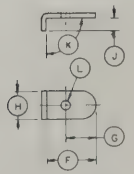


NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. MATERIALS:
   a. CHIMNEY
      TEFLON TFE
   b. TOE CLAMP
      BRASS - SILVER PLATED



DIM	INCHES MIN	INCHES MAX	INCHES REF	MILLIMETERS MIN	MILLIMETERS MAX	MILLIMETERS REF
A	3.187	3.281	- -	80.95	83.34	- -
B	3.374	3.445	- -	85.70	87.50	- -
C	.055	0.135		.40	3.43	-
D	1.210	.290	- -	30.73	32.77	- -
E	- -	- -	4.562	- -	- -	115.9

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. MATERIAL:
   a. CHIMNEY: POLYESTER PREMIX COMPOUND FIBERGLASS PER MIL-Y-1140, RESIN PER MIL-R-7575 MAX OPERATING TEMP 125° C
   b. CHIMNEY CLIP. BERYLLIUM COPPER, HEAT TREATED & CADMIUM PLATED



TOE CLAMP DETAIL
(4) SUPPLIED
P/N 889901

SK-2206 Chimney

SK-2216 Chimney



EIMAC
Division of Varian
San Carlos, California

EIMAC and JEDEC
POWER GRID TUBE NUMBER
CROSS-REFERENCE LIST

JULY 15, 1970

(Revised 7-15-70) © 1965, 1968, 1969, 1970 Varian Associates Printed in U.S.A.

Eimac No.	JEDEC No.
KY21A	----
RX21A	----
2-01C	----
2-25A	----
2-50A	----
2-150D	----
2-240A	----
2-450A	----
2-2000A	----
2C39A	2C39A
2C39WA	2C39WA
2X1000A	----
2X3000F	----
3C24	3C24
3-200A3	592
3-400Z	8163
3-500Z	----
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CV30,000A1	----
3CV30,000A3	----
3CV30,000H3	----
3CW5000A1	8240
3CW5000A3	8242
3CW5000F1	8241
3CW5000F3	8243
3CW5000H3	----
3CW10,000A3	----
3CW10,000H3	----
3CW20,000A1	----
3CW20,000A3	----
3CW20,000A7	----
3CW20,000H3	----
3CW25,000A3	----
3CW30,000H3	----
3CW40,000H3	----
3CW100,000H3	----
3CX100A5	7289
3CX100F5	8250
3CX400A7	8873
3CX1000A7	8283
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	----
3CX3000A1	8238
3CX3000A7	----
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	----
3CX5000H3	----
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	----
3CX15,000A3	----
3CX15,000A7	----
3CX15,000H3	----
3CX20,000A3	----
3CX20,000H3	----
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-500A	----
4-1000A	8166
4CN15A	----
4CPX250K	8590
4CS250H	----
4CS250HA	----
4CS250R	----

Eimac No.	JEDEC No.
4CV1500B	----
4CV8000A	----
4CV20,000A	----
4CV35,000A	----
4CV50,000E	----
4CV50,000J	----
4CV75,000A	----
4CV100,000C	8351
4CV250,000A	----
4CV250,000V	----
4CW800B	----
4CW800F	----
4CW2000A	8244
4CW10,000A	8661
4CW25,000A	----
4CW50,000E	----
4CW100,000D	----
4CW100,000E	----
4CW250,000A	----
4CW250,000V	----
4CX125C	----
4CX125F	----
4CX250B	7203
4CX250F	7204
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX600B	----
4CX600F	----
4CX600J	8809
4CX1000A	8168
4CX1000K	8352
4CX1500A	----
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	----
4CX5000R	8170W
4CX10,000D	8171
4CX15,000A	8281
4CX15,000J	----
4CX35,000C	8349
4D21A	4D21A
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	----
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X500A	----
5-125B	4E27A
5-500A	----
5CX1500A	----
5CX3000A	----
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL

Eimac No.	JEDEC No.
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
175A	----
177A	----
177WA	----
250R	----
250TH	250TH
250TL	250TL
253	253
254W	----
264	8576
279	----
284	----
290	----
294	----
304TH	304TH
304TL	304TL
322	----
450TH	450TH
450TL	450TL
575A	575A
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6884	6884
6894	6894
6895	6895
7211	7211
7457	7457
7480	7480
7527	7527
7609	7609
7698	7698
7815AL	7815AL
7815RAL	7815RAL
7843	7843
7855	7855
7855K	7855K
7855KAL	7855KAL
8072	8072
8121	8121
8122	8122
8295A	8295A
8403	8403
8432	8432
8533	8533
8560A	8560A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8847	8847
8892	8892
8893	8893

NUMBER CROSS-REFERENCE LIST

JEDEC to EIMAC

JEDEC No.	Eimac No.
2C39A	2C39A
2C39WA	2C39WA
4D21	4-125A
4D21A	4D21A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
575A	575A
592	3-200A3
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6884	6884
6894	6894
6895	6895
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	7211
7289	3CX100A5
7457	7457
7480	7480
7527	7527
7580W	4CX250R
7609	7609
7698	7698
7815	3CPN10A5
7815AL	7815AL
7815R	3CPX100A5
7815RAL	7815RAL
7843	7843
7855	7855
7855K	7855K
7855KAL	7855KAL
8020	100R
8072	8072
8121	8121
8122	8122
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295A	8295A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8432	8432
8438	4-400A
8533	8533
8560A	8560A
8561	4CX300Y
8576	264
8590	4CPX250K
8621	4CX250FG
8660	4CX1500B
8661	4CW10,000A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8809	4CX600J
8847	8847
8873	3CX400A7
8892	8892
8893	8893


Eimac®



EIMAC
Division of Varian
San Carlos, California

EIMAC and JEDEC
CROSS-REFERENCE LIST

JANUARY 15, 1971

(Revised 1-15-71) © 1971 Varian Associates Printed in U.S.A.

EIMAC/JEDEC CROSS-REFERENCE LIST

EIMAC to JEDEC

EIMAC No.	JEDEC No.
KY21A	----
RX21A	----
2-01C	----
2-25A	----
2-50A	----
2-150D	----
2-240A	----
2-450A	----
2-2000A	----
2C39A	2C39A
2C39WA	2C39WA
2X1000A	----
2X3000F	----
3C24	3C24
3-200A3	592
3-400Z	8163
3-500Z	----
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CV1500A7	----
3CV30,000A1	----
3CV30,000A3	----
3CV30,000H3	----
3CW5000A1	8240
3CW5000A3	8242
3CW5000F1	8241
3CW5000F3	8243
3CW5000H3	----
3CW10,000A3	----
3CW10,000H3	----
3CW20,000A1	----
3CW20,000A3	----
3CW20,000A7	----
3CW20,000H3	----
3CW25,000A3	----
3CW30,000H3	----
3CW40,000H3	----
3CW100,000H3	----
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8283
3CX1500A7	8877
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	----
3CX3000A1	8238
3CX3000A7	----
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	----
3CX5000H3	----
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	----
3CX15,000A3	----
3CX15,000A7	----
3CX15,000H3	----
3CX20,000A3	----
3CX20,000H3	----
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-500A	----
4-1000A	8166
4CN15A	----
4CPX250K	8590
4CS250H	----
4CS250HA	----
4CS250R	----
4CV1500B	----
4CV8000A	----
4CV20,000A	----
4CV35,000A	----
4CV50,000E	----
4CV50,000J	----
4CV75,000A	----
4CV100,000C	8351
4CV250,000A	----
4CV250,000V	----
4CW800B	----
4CW800F	----
4CW2000A	8244
4CW10,000A	8661
4CW25,000A	----
4CW50,000E	----
4CW100,000D	----
4CW100,000E	----
4CW250,000A	----
4CW250,000V	----
4CX125C	----
4CX125F	----
4CX250B	7203
4CX250F	7204
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX350FJ	8904
4CX600B	----
4CX600F	----
4CX600J	8809
4CX1000A	8168
4CX1000K	8352
4CX1500A	----
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	8909
4CX5000R	8170W
4CX10,000D	8171
4CX10,000J	----
4CX15,000A	8281
4CX15,000J	8910
4CX35,000C	8349
4D21A	4D21A
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	----
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X500A	----
5-125B	4E27A
5-500A	----
5CX1500A	----
5CX3000A	----
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
175A	----
177A	----
177WA	----
250R	----
250TH	250TH
250TL	250TL
253	253
254W	----
264	8576
279	----
284	----
290	----
294	----
304TH	304TH
304TL	304TL
322	----
450TH	450TH
450TL	450TL
575A	575A
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6816	6816
6884	6884
6894	6894
6895	6895
7211	7211
7457	7457
7480	7480
7527	7527
7609	7609
7698	7698
7815AL	7815AL
7815RAL	7815RAL
7843	7843
7855	7855
7855K	7855K
7855KAL	7855KAL
8072W	8072W
8121W	8121W
8122W	8122W
8295A	8295A
8403	8403
8432	8432
8533	8533
8560A	8560A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8847	8847
8847A	8847A
8892	8892
8893	8893
8906	8906
8907	8907
8911	8911
8912	8912

JEDEC to EIMAC

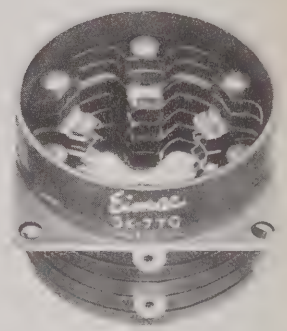
JEDEC No.	EIMAC No.
2C39A	2C39A
2C39WA	2C39WA
3C24	3C24
4D21	4-125A
4D21A	4D21A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
575A	575A
592	3-200A3
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6816	6816
6884	6884
6894	6894
6895	6895
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	7211
7289	3CX100A5
7457	7457
7480	7480
7527	7527
7580W	4CX250R
7609	7609
7698	7698
7815	3CPN10A5
7815AL	7815AL
7815R	3CPX100A5
7815RAL	7815RAL
7843	7843
7855	7855
7855K	7855K
7855KAL	7855KAL
8020	100R
8072W	8072W
8121W	8121W
8122W	8122W
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295A	8295A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8403	8403
8432	8432
8438	4-400A
8533	8533
8560A	8560A
8561	4CX300Y
8576	264
8590	4CPX250K
8621	4CX250FG
8660	4CX1500B
8661	4CW10,000A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8809	4CX600J
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8877	3CX1500A7
8892	8892
8893	8893
8904	4CX350FJ
8906	8906
8907	8907
8909	4CX5000J
8910	4CX15,000J
8911	8911
8912	8912


Eimac

EIMAC
Division of Varian

SK-760
SK-770

AIR-SYSTEM SOCKETS



The EIMAC SK-760 and SK-770 Air-System Sockets are recommended for use with those tubes listed at the bottom of the page or other tube types having this special breech-block base. These sockets incorporate a built-in integral chimney. When these sockets are used, connection is made to each of the tube electrodes except the anode. The screen contacts on the SK-760 are not connected to the metal mounting plate, while the screen contacts on the SK-770 are connected to the metal mounting plate. The SK-760 has no grounded contacts. The SK-760 and SK-770 are humidity and salt spray resistant.

BASE CONNECTIONS

The SK-760 and SK-770 Air-System Sockets consist of five sets of ring contacts. They are (from top to bottom): 1)-screen-grid, 2)-control-grid, 3)-cathode, 4)-heater, 5)-heater. Each set of contacts consist of six separate contact tabs. The tube elements are connected to their external circuits by two diametrically opposed solder terminals.

MATERIALS AND FINISHES

The mounting plates of these sockets are fabricated of nickel-plated brass. Contact rings and tabs are made of beryllium copper, per QQ-C-533, heat-treated after forming, then silver-plated. The rivets and washers are of brass, silver and nickel-plated respectively. All silver-plating is in accordance with QQ-S-365 and nickel-plating per QQ-N-290. The ten contact terminals are solder-dipped to insure firm, dependable solder contact. The insulating wafers and the stop yoke of the sockets are molded of a flameproof diallyl meta-phthalate per MIL-P-19833.

INSTALLATION

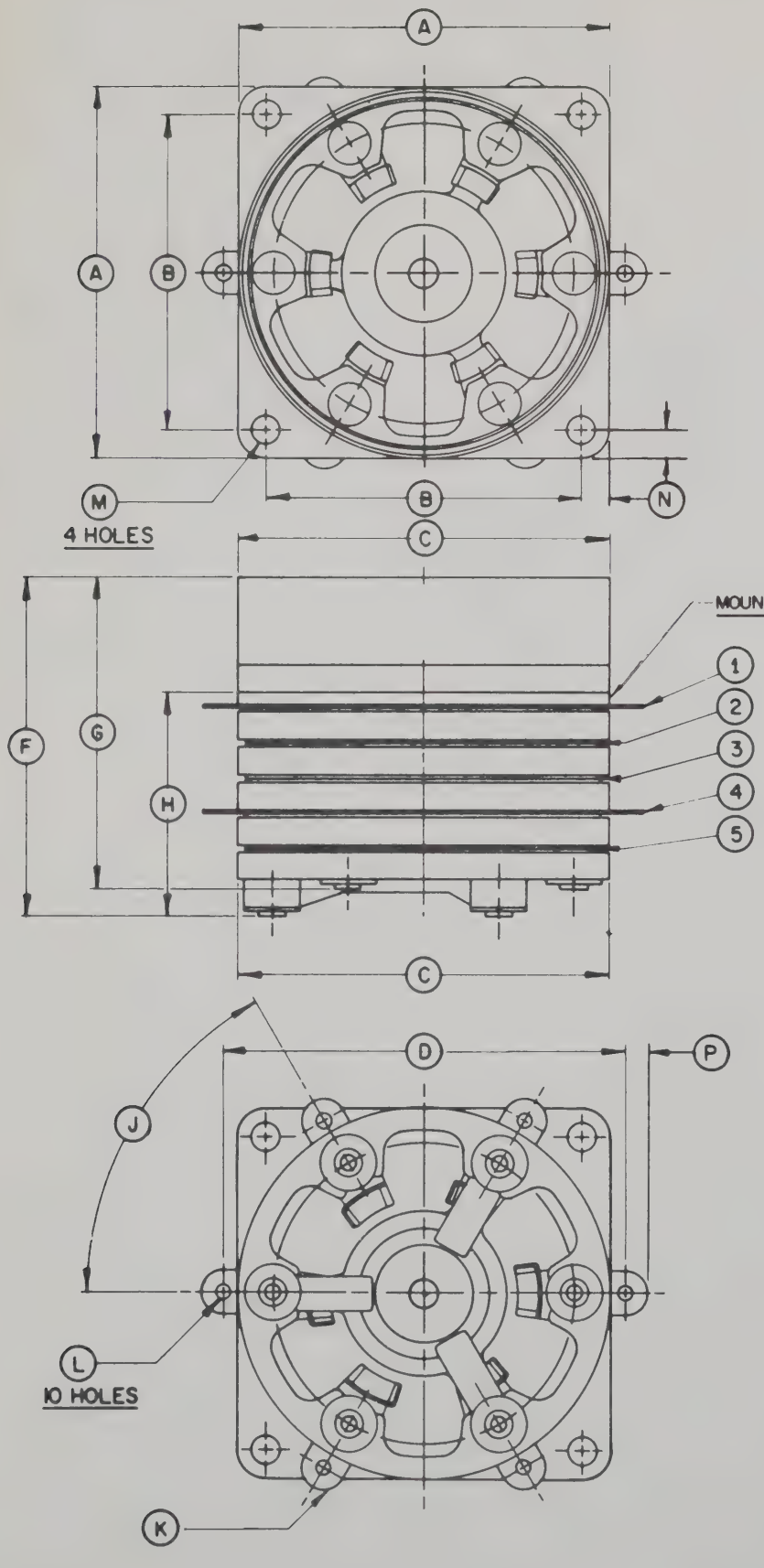
The SK-760 and SK-770 Air-System Sockets were designed for under-chassis mounting and require a 1.593 inches diameter hole through the chassis deck. Four screw holes are provided for fastening as shown on the outline drawing.

The SK-760 and SK-770 Air-System Sockets are recommended for use with the following tube types:

4CN15A 4CX300A 4CX300Y

NET WEIGHT . . . . . 1.5 oz; (42.5 gm)

(Revised 7-27-70) © 1963, 1966, 1970 Varian Printed in U.S.A.



DIMENSIONAL DATA

DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	1.615	1.635	- -	41.00	41.40	- -
B	1.360	1.390	- -	34.57	35.25	- -
C	1.615 D.	1.635 D.	- -	41.00 D.	41.40 D.	- -
D	1.735	1.765	- -	43.90	44.83	- -
F	1.330	1.370	- -	33.75	34.80	- -
G	1.205	1.245	- -	30.60	31.66	- -
H SK760	1.020	1.060	- -	25.91	26.92	- -
H SK770	.931	.971	- -	23.70	24.70	- -
J	- -	- -	60°	- -	- -	60°
K	- -	- -	3/32 R.	- -	- -	2.38R.
L	- -	- -	1/16 D.	- -	- -	1.59 D.
M	.134 D.	.154 D.	- -	3.40 D.	3.92 D.	- -
N	.120	.130	- -	3.05	3.30	- -
P	.078	.109	- -	1.98	2.77	- -

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

CONNECTIONS
1. SCREEN GRID
2. CONTROL GRID
3. CATHODE
4. HEATER
5. HEATER



EIMAC
Division of Varian
San Carlos, California

EIMAC and JEDEC
CROSS-REFERENCE LIST

JULY 1, 1971

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EIMAC/JEDEC CROSS-REFERENCE LIST

EIMAC to JEDEC

EIMAC No.	JEDEC No.
KY21A	----
RX21A	----
2-01C	----
2-25A	----
2-50A	----
2-150D	----
2-240A	----
2-450A	----
2-2000A	----
2C39A	2C39A
2C39WA	2C39WA
2X1000A	----
2X3000F	----
3C24	3C24
3-200A3	592
3-400Z	8163
3-500Z	----
3-1000Z	8164
3CPN10A5	7815
3CPX100A5	7815R
3CV1500A7	----
3CV30,000A1	----
3CV30,000A3	----
3CV30,000H3	----
3CV50,000A7	----
3CW5000A1	8240
3CW5000A3	8242
3CW5000F1	8241
3CW5000F3	8243
3CW5000H3	----
3CW10,000A3	----
3CW10,000H3	----
3CW20,000A1	----
3CW20,000A3	----
3CW20,000A7	----
3CW20,000H3	----
3CW25,000A3	----
3CW30,000H3	----
3CW40,000H3	----
3CX100A5	7289
3CX100F5	8250
3CX1000A7	8283
3CX1500A7	8877
3CX2500A3	8161
3CX2500F3	8251
3CX2500H3	----
3CX3000A1	8238
3CX3000A7	----
3CX3000F1	8239
3CX3000F7	8162
3CX5000A3	----
3CX5000H3	----
3CX10,000A1	8158
3CX10,000A3	8159
3CX10,000A7	8160
3CX10,000H3	----
3CX15,000A3	----
3CX15,000A7	----
3CX15,000H3	----
3CX20,000A3	----
3CX20,000H3	----
4-65A	8165
4-125A	4D21
4-250A	5D22
4-400A	8438
4-400B	7527
4-400C	6775
4-500A	----
4-1000A	8166
4CN15A	----
4CPX250K	8590
4CS250H	----
4CS250HA	----
4CS250R	----
4CV1500B	----
4CV8000A	----
4CV20,000A	----
4CV35,000A	----
4CV50,000E	----
4CV50,000J	----
4CV75,000A	----
4CV100,000C	8351
4CV250,000A	----
4CV250,000V	----
4CW800B	----
4CW800F	----
4CW2000A	8244
4CW10,000A	8661
4CW25,000A	----
4CW50,000E	----
4CW50,000J	----
4CW100,000D	----
4CW100,000E	----
4CW250,000A	----
4CW250,000V	----
4CX125C	----
4CX125F	----
4CX250B	7203
4CX250F	7204
4CX250FG	8621
4CX250K	8245
4CX250M	8246
4CX250R	7580W
4CX300A	8167
4CX300Y	8561
4CX350A	8321
4CX350F	8322
4CX350FJ	8904
4CX600B	----
4CX600F	----
4CX600J	8809
4CX600JA	8921
4CX1000A	8168
4CX1000K	8352
4CX1500A	----
4CX1500B	8660
4CX3000A	8169
4CX5000A	8170
4CX5000J	8909
4CX5000R	8170W
4CX10,000D	8171
4CX10,000J	----
4CX15,000A	8281
4CX15,000J	8910
4CX35,000C	8349
4D21A	4D21A
4PR60B	8252
4PR60C	8252W
4PR65A	8187
4PR125A	8247
4PR250C	8248
4PR400A	8188
4PR1000A	8189
4PR1000B	----
4W300B	8249
4W20,000A	8173
4X150A	7034
4X150D	7035
4X150G	8172
4X500A	----
5-125B	4E27A
5-500A	----
5CX1500A	----
5CX3000A	----
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100R	8020
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
175A	----
177A	----
177WA	----
250R	----
250TH	250TH
250TL	250TL
253	253
254W	----
264	8576
279	----
284	----
290	----
294	----
304TH	304TH
304TL	304TL
322	----
450TH	450TH
450TL	450TL
575A	575A
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	6775
6816	6816
6884	6884
6894	6894
6895	6895
7211	7211
7457	7457
7480	7480
7609	7609
7698	7698
7815AL	7815AL
7815RAL	7815RAL
7843	7843
7855	7855
7855K	7855K
7855KAL	7855KAL
8072W	8072W
8121W	8121W
8122W	8122W
8295A	8295A
8403	8403
8432	8432
8533	8533
8560A	8560A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8828W	8828W
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8892	8892
8893	8893
8906	8906
8907	8907
8911	8911
8912	8912

JEDEC to EIMAC

JEDEC No.	EIMAC No.
2C39A	2C39A
2C39WA	2C39WA
3C24	3C24
4D21	4-125A
4D21A	4D21A
4E27A	5-125B
5D22	4-250A
6C21	6C21
25T	25T
35T	35T
35TG	35TG
75TH	75TH
75TL	75TL
100TH	100TH
100TL	100TL
152TH	152TH
152TL	152TL
250TH	250TH
250TL	250TL
253	253
304TH	304TH
304TL	304TL
450TH	450TH
450TL	450TL
575A	575A
592	3-200A3
673	673
750TL	750TL
826	826
869B	869B
869B/L	869B/L
1000T	1000T
1500T	1500T
2000T	2000T
5867A	5867A
6155	6155
6156	6156
6549	6549
6569	6569
6580	6580
6696A	6696A
6697A	6697A
6775	4-400C
6816	6816
6884	6884
6894	6894
6895	6895
7034	4X150A
7035	4X150D
7203	4CX250B
7204	4CX250F
7211	7211
7289	3CX100A5
7457	7457
7480	7480
7527	4-400B
7580W	4CX250R
7609	7609
7698	7698
7815	3CPN10A5
7815AL	7815AL
7815R	3CPX100A5
7815RAL	7815RAL
7843	7843
7855	7855
7855K	7855K
7855KAL	7855KAL
8020	100R
8072W	8072W
8121W	8121W
8122W	8122W
8158	3CX10,000A1
8159	3CX10,000A3
8160	3CX10,000A7
8161	3CX2500A3
8162	3CX3000F7
8163	3-400Z
8164	3-1000Z
8165	4-65A
8166	4-1000A
8167	4CX300A
8168	4CX1000A
8169	4CX3000A
8170	4CX5000A
8170W	4CX5000R
8171	4CX10,000D
8172	4X150G
8173	4W20,000A
8187	4PR65A
8188	4PR400A
8189	4PR1000A
8238	3CX3000A1
8239	3CX3000F1
8240	3CW5000A1
8241	3CW5000F1
8242	3CW5000A3
8243	3CW5000F3
8244	4CW2000A
8245	4CX250K
8246	4CX250M
8247	4PR125A
8248	4PR250C
8249	4W300B
8250	3CX100F5
8251	3CX2500F3
8252	4PR60B
8252W	4PR60C
8281	4CX15,000A
8283	3CX1000A7
8295A	8295A
8321	4CX350A
8322	4CX350F
8349	4CX35,000C
8351	4CV100,000C
8352	4CX1000K
8403	8403
8432	8432
8438	4-400A
8533	8533
8560A	8560A
8561	4CX300Y
8576	264
8590	4CPX250K
8621	4CX250FG
8660	4CX1500B
8661	4CW10,000A
8745	8745
8755	8755
8755A	8755A
8756	8756
8757	8757
8809	4CX600J
8828W	8828W
8847	8847
8847A	8847A
8873	8873
8874	8874
8875	8875
8876	8876
8877	3CX1500A7
8892	8892
8893	8893
8904	4CX350FJ
8906	8906
8907	8907
8909	4CX5000J
8910	4CX15,000J
8911	8911
8912	8912
8921	4CX600JA


Eimac

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

8167
4CX300A
CERAMIC POWER TETRODE

The Eimac 4CX300A is a compact integral-finned external-anode power tetrode having a maximum plate-dissipation rating of 300 watts. The 4CX300A may be operated at frequencies up to 500 megacycles.

The all-ceramic-and-metal construction and the internally-unitized electrode structure combine to make the 4CX300A especially durable and free from mechanically-induced noise under conditions of severe acceleration caused by shock or vibration.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage (See "Application")		6.0		volts
Current (E_f=6.0 volts)	2.2		3.2	amperes
Amplification Factor (Grid to Screen)	4.0		5.6	
Transconductance (I_b=200 ma.)		12,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	25		33	uuf
Output	3.5		4.5	uuf
Feedback			0.06	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Nom.	Max.	
Input	-	16.2		uuf
Output	3.5		4.5	uuf
Feedback	-	0.01		uuf
Frequency for Maximum Ratings	-	-	500	mc

MECHANICAL

Base	Special, breechblock terminal surfaces
Recommended Socket	Eimac SK-700 Series
Operating Position	Any
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	- 250° C
Anode Core	- 250° C
Cooling	Forced Air
Maximum Over-All Dimensions:	
Height	2.5 inches
Diameter	1.65 inches
Net Weight	4 ounces
Shipping Weight (Approximate)	1 pound

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	500	1000	1500	2000	2500***	2000	volts
D-C Screen Voltage	250	250	250	250	250	250	volts
D-C Grid Voltage	—90	—90	—90	—90	—90	—90	volts
D-C Plate Current	250	250	250	250	250	250	ma
D-C Screen Current*	45	38	21	19	16	10**	ma
D-C Grid Current*	35	31	28	26	25	25**	ma
Peak R-F Grid Voltage*	114	114	112	112	111	—	volts
Driving Power*	4.0	3.5	3.2	2.9	2.8	—	watts
Plate Input Power	125	250	375	500	625	500	watts
Plate Output Power	70	190	280	390	500	225**	watts
Heater Voltage						5.5	volts

*Approximate values.
**Measured values for a typical cavity amplifier circuit at 500 Mc.
***For operation below 250Mc. only.

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AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	200	200	200	200	ma
Max-Signal D-C Plate Current	500	500	500	500	ma
Max-Signal D-C Screen Current	20	16	10	8	ma
Effective Load, Plate to Plate	3500	6200	9500	11,600	ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50	50	volts
Driving Power	0	0	0	0	watts
Max-Signal Plate Output Power	240	430	600	800	watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	100	100	100	100	ma
D-C Plate Current	150	150	150	150	ma
D-C Screen Current*	—3	—4	—4	—4	ma
Peak R-F Grid Voltage*	25	25	25	25	volts
Plate Output Power	30	50	65	85	watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Peak-envelope conditions except where noted)

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	100	100	100	100	ma
Peak R-F Grid Voltage*	50	50	50	50	volts
D-C Plate Current	250	250	250	250	ma
D-C Screen Current*	10	8	5	4	ma
Plate Input Power	250	375	500	625	watts
Plate Output Power	120	215	300	400	watts
Two-Tone Average D-C Plate Current	190	190	190	190	ma
Two-Tone Average D-C Screen Current*	2	—1	—2	—2	ma

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	200 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	500	1000	1500	volts
D-C Screen Voltage	250	250	250	volts
D-C Grid Voltage	—100	—100	—100	volts
D-C Plate Current	200	200	200	ma
D-C Screen Current*	31	22	20	ma
D-C Grid Current*	15	14	14	ma
Peak R-F Grid Input Voltage*	118	117	117	volts
Driving Power*	1.8	1.7	1.7	watts
Plate Input Power	100	200	300	watts
Plate Output Power	60	145	235	watts

*Approximate values.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. The driving power and output power shown are substantially correct at frequencies below 175 Mc. Allowance must be made for grid and plate circuit losses. At frequencies above 175 Mc. additional allowance must be made for high-frequency effects within the tube itself. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

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APPLICATION

MECHANICAL

Mounting—The 4CX300A may be operated in any position. Recommended sockets for the 4CX300A are the Eimac Air-System Sockets type SK-700 (ungrounded cathode) or type SK-710 (cathode and one heater contact grounded). Both sockets provide connections to all electrodes except the anode and each incorporates a screen by-pass capacitor of approximately 1100 uuf. The SK-606 chimney is recommended for use with the SK-700 and SK-710 sockets.

Other sockets suitable for use with the 4CX300A include the SK-740, SK-760, and SK-770. These sockets do not incorporate screen by-pass capacitors. The SK-760 and SK-770 incorporate integral air chimneys. Screen contacts are connected to the mounting flange in the SK-770 and are, therefore, grounded when the socket is installed in the usual manner.

Cooling—The maximum rated ceramic-to-metal seal temperature for the 4CX300A is 250°C. Adequate forced-air cooling must be provided to assure that this maximum temperature rating is not exceeded. Airflow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
100	2.2	0.065	3.2	0.095
150	3.4	0.14	4.9	0.21
200	4.6	0.26	6.7	0.37
250	5.9	0.40	8.6	0.58
300	7.2	0.58	10.5	0.85

A new, more efficient cooling fin design is incorporated in the 4CX300A which results in lower airflow requirements. This is reflected in the table above (which assumes the use of an Eimac SK-700 or SK-710 socket and SK-606 chimney).

At high altitudes and high ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using the maximum rated temperature as the criterion for satisfactory cooling.

Cooling effectiveness should also be determined on an individual basis if the 4CX300A is operated immersed in an insulating fluid such as silicone oil, again using the maximum rated temperature as the criterion.

Impact and Vibration—The 4CX300A is designed to operate under impact or vibration capable of disabling a conventional tube of similar power capabilities. Impact forces up to 50g with 11-millisecond duration, or vibratory accelerations up to 20g at frequencies from 20 to 2000 cycles per second, will not destroy a normal 4CX300A unless unduly prolonged.

It is not suggested that the 4CX300A be subjected to abusive treatment unnecessarily, but in applications where operation under severe environmental conditions is unavoidable the 4CX300A will provide more reliable service than will conventional tubes.

ELECTRICAL

Heater Operation—The rated heater voltage for the 4CX300A is 6.0 volts. At frequencies higher than 300 megacycles the heater voltage should be reduced according to the following schedule:

Frequency (Mc.)	Heater Voltage (Volts)
Up to 300	6.00
300 to 400	5.75
400 to 500	5.50

The heater voltage must be maintained within ± 5% of the selected operating voltage if variations in circuit performance are to be minimized and best tube life obtained.

Cathode Operation—The 4CX300A employs a cylindrical indirectly-heated oxide-coated unipotential cathode. The minimum warm-up time is 30 seconds when rated heater voltage is applied.

Grid Operation—The 4CX300A control grid has a maximum dissipation rating of 2.0 watts, and precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the Typical Operation sections of the data sheet whenever possible.

At frequencies higher than 300 Mc., the driving power required by the circuits associated with the tube begins to increase, until at 500 Mc., as much as 30 watts of driving power may be required. The power dissipated by the control grid increases only slightly, however, in spite of the greatly increased driving power required by the circuit. Satisfactory 500-megacycle operation of the 4CX300A in a stable, "straight-through" amplifier is indicated by grid-current values below approximately 25 milliamperes.

In class-A and class-AB_1 amplifiers, where no grid current flows, the grid bias voltage may be applied through a resistor. The maximum permissible series resistance per tube is 100,000 ohms.

Screen Operation—The maximum rated screen dissipation for the 4CX300A is 12 watts. The maximum rated d-c screen supply voltage is 300 volts when the tube is operated in class-C amplifier or oscillator service, and 400 volts when the tube is operated in class-AB or class-B amplifier service.

Under certain operating conditions the screen current of a tetrode may reverse. This makes it dangerous to rely on a screen-dropping resistor or a series regulator to supply the screen voltage unless a bleeder or regulator tube is connected from screen to cathode. This bleeder should draw at least 15 milliamperes for each tube connected to the screen supply.

The power input to the screen can be calculated from the voltage and current whenever the screen-to-cathode potential does not vary. Screen modulation or cathode driving of tetrode amplifiers can lead to errors in measurement of screen input when the effective voltage and current exceed the indicated d-c values. When there is reason to suspect that the screen input exceeds the indicated power, it is advisable to maintain the indicated screen power input below approximately 75% of the rated screen dissipation.

A screen by-pass capacitor of approximately 1100 uuf is incorporated in the body of the Eimac SK-700 and SK-710 Air-System Sockets and is adequate for

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normal amplifier operation at high and ultra-high radio frequencies. Operation at low radio frequencies or audio frequencies may require that additional capacitance be connected externally. In the latter case, the screen by-pass capacitance within the socket helps to eliminate the high-frequency parasitic oscillations occasionally encountered in tetrode amplifiers.

The self-neutralizing frequency of the 4CX300A is above the useful high-frequency limit for the tube when either of the sockets with integral screen by-pass capacitors is used.

Plate Operation—The 4CX300A has a finned external anode for forced-air cooling. Connection to the anode may be made at the top cap or cylindrical cooler shell. The latter is usually used when the tube is installed in coaxial lines or cavities.

The absolute maximum plate-dissipation rating for the 4CX300A is 300 watts, which is also the rated maximum dissipation for class-C amplifier or oscillator applications and for class-B or class-AB amplifier applications. When the 4CX300A is used in plate-modulated amplifier applications, the plate-dissipation rating is 200 watts under carrier conditions, rising to 300 watts under 100% sine-wave modulation. Plate dissipation may be permitted to exceed the maximum rated value for brief periods, such as may occur while tuning.

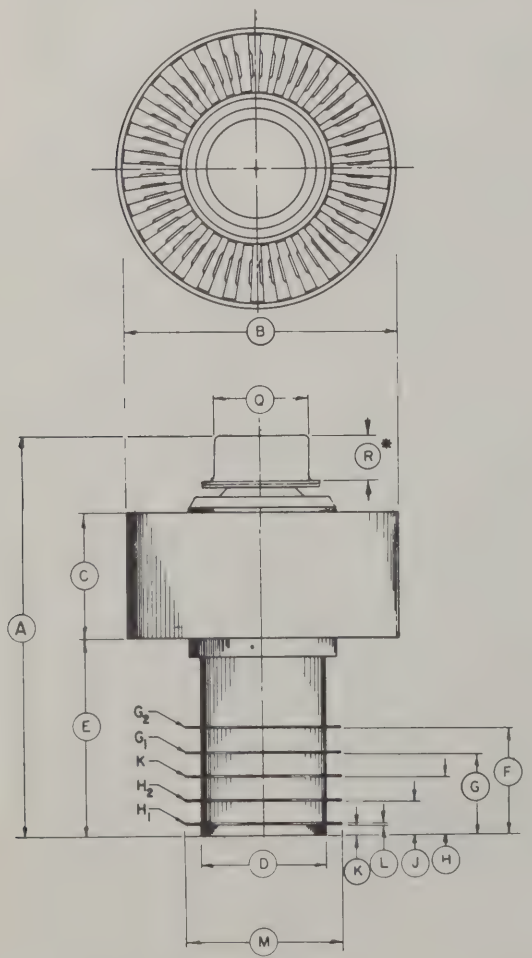
The maximum rated plate voltage for class-AB_1 operation at frequencies up to 500 megacycles is 2500 volts. In class-C telegraphy and plate-modulated service the maximum rated plate voltage for operation up to 500 megacyles is 2000 and 1500 volts respectively. However, at frequencies below 250 megacycles, a plate potential of 2500 volts may be used in class-C telegraphy and FM telephony service.

Modulation—The 4CX300A can be modulated by any of the methods commonly used with tetrode tubes. Its large reserve plate dissipation makes it especially suited for use in screen-modulated and linear amplifiers in which the plate efficiency is low.

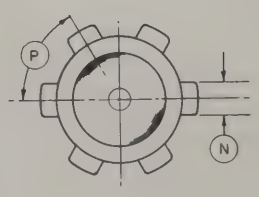
Plate modulation can be appplied to the 4CX300A when it is operated as a class-C amplifier. To obtain 100% modulation with minimum distortion the screen supply voltage should be modulated in phase with the modulation applied to the plate supply voltage. Screen voltage modulation factors between 0.75 and 1.00 may be used.

"Self-modulation" of the screen by means of a resistor in series with the screen supply line is not recommended because of the effects which require a bleeder from screen to cathode as described under "Screen Operation" above.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Eitel-McCullough, Inc. for information and recommendations.

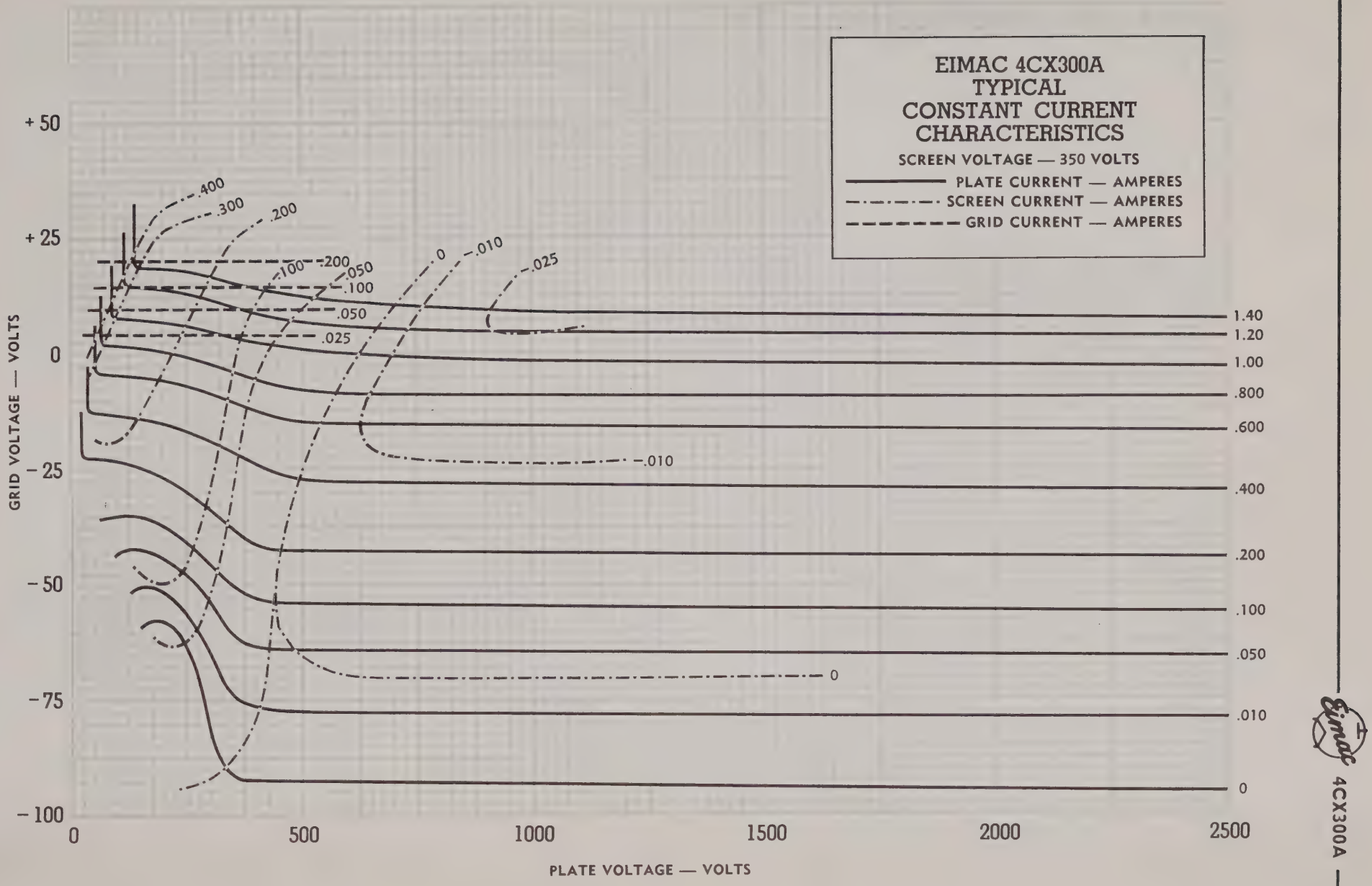


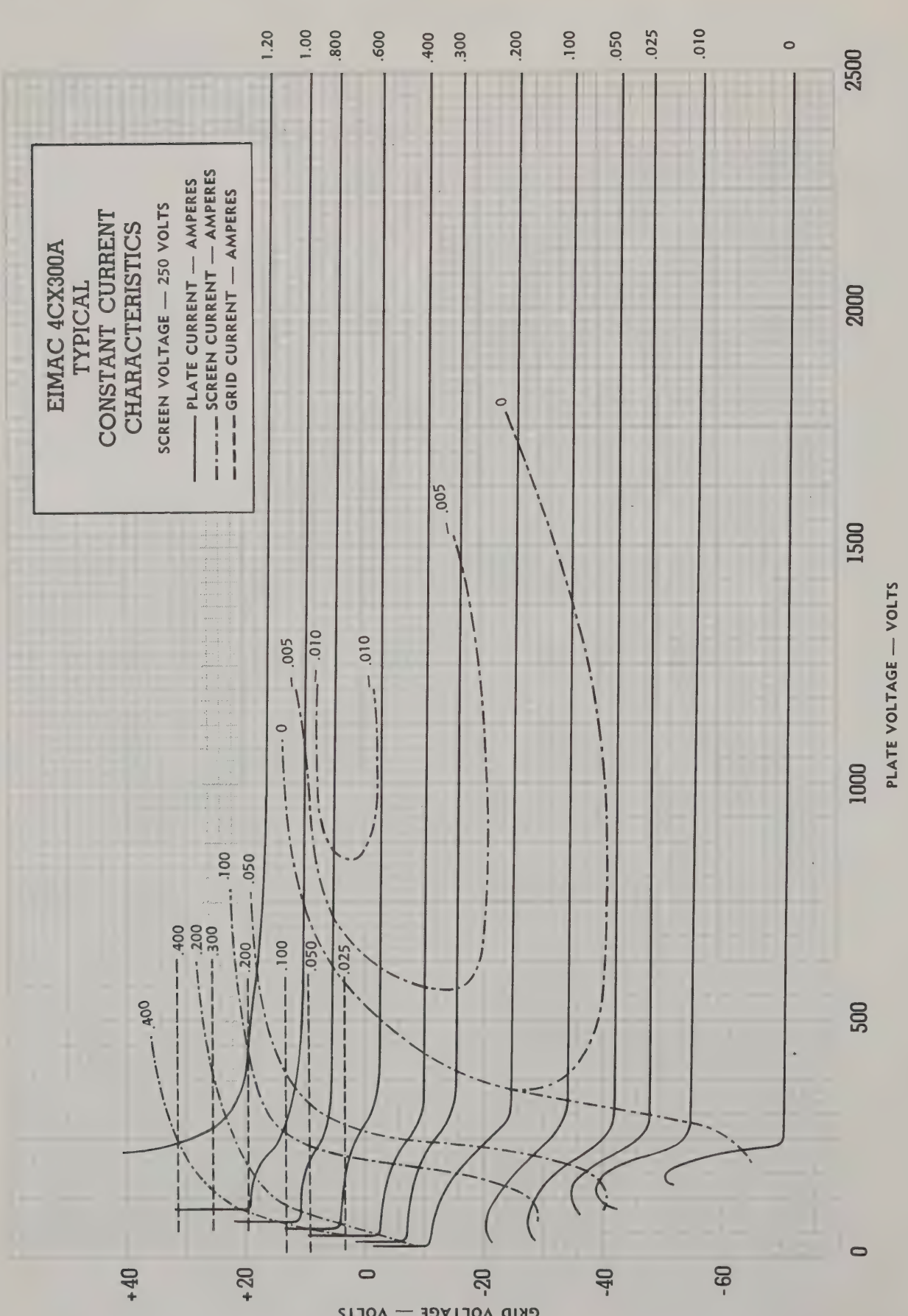
DIMENSION DATA			
REF	NOM.	MIN.	MAX.
A		2.300	2.500
B		1.610	1.640
C		.710	.790
D		.740	.770
E		1.133	1.195
F		.602	.642
G		.470	.500
H		.329	.359
J		.193	.213
K		.050	.072
L		.010	.020
M		.936	.956
N		.170	.185
P	60°		
Q		.559	.573
R		.240	.280



*CONTACT SURFACE

▶ Indicates change from sheet dated 11-10-59


EIMAC 4CX300A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 350 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
+ 50
+ 25
0
– 25
– 50
– 75
– 100
GRID VOLTAGE — VOLTS
0
500
1000
1500
2000
2500
PLATE VOLTAGE — VOLTS
.400
.300
.200
.200
.100
.050
.025
.100
.050
.025
0
.010
.025
.010
0
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0



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EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

4CX600B
4CX600F

RADIAL BEAM POWER TETRODE

The EIMAC 4CX600B and 4CX600F are ceramic/metal, air cooled radial beam tetrodes designed for use in wideband amplifiers, particularly distributed amplifiers.

The mechanical and electrical features of these tubes are compatible with wideband amplifier circuit requirements; i.e., low lead inductance, low input and output capacitances, small size and high transconductance.

Rugged construction consisting of a unitized electrode structure and direct mounting to the chassis combine to make the 4CX600B and 4CX600F suitable for environments of severe shock and vibration.

The maximum rated plate dissipation of either type is 600 watts.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: (4CX600B) Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	4.3	A
Cathode: (4CX600F) Oxide Coated, Unipotential		
Heater: Voltage	26.5 ± 1.3	V
Current, at 26.5 volts	1.05	A
Transconductance (Average):		
I_b = 0.6 Adc	41,000	μmhos
Input Conductance:		
Ib = 0.6 Adc (F = 30 MHz)	0.1×10^{-3}	mhos
Direct Interelectrode Capacitances (grounded cathode)[2]		
Input	45	pF
Output	5.8	pF
Feedback	0.10	pF
Frequency of Maximum Rating:		
CW	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

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MECHANICAL

Maximum Overall Dimensions:

Length	2.45 in; 62.23 mm
Diameter	2.08 in; 52.83 mm
Net Weight	7.0 oz; 198 gm
Operating Position	Any

Maximum Operating Temperature:

Ceramic/Metal Seals and Anode Core	250°C
SK-680 capacitor when used	150°C
Cooling	Air
Base	Special

BROADBAND LINEAR AMPLIFIER
Class AB

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-150	VOLTS
DC PLATE CURRENT	0.6	AMPERE
PLATE DISSIPATION	600	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	3	WATTS

TYPICAL OPERATION

Plate Voltage	1000	1500	2500	Vdc
Screen Voltage	275	275	275	Vdc
Grid Voltage [1]	-40	-40	-40	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	570	580	585	mAdc
Single-Tone Screen Current [2]	32	29	17	mAdc
Peak rf Grid Voltage	44	43	42	v
Screen Dissipation	8.8	8.0	4.7	W
Plate Input Power	570	870	1460	W
Plate Dissipation	250	280	460	W
Plate Output Power	320	590	1000	W
Rf Load Impedance	765	1225	2325	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER

(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS (890 MHz):

DC PLATE VOLTAGE	2500	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-150	VOLTS
DC PLATE CURRENT	0.6	AMPERE
PLATE DISSIPATION	600	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	3	WATTS

1. Approximate value

2. Grid driven, neutralized coaxial cavity. Grounded screen, rf grounded cathode. Class AB.

3. For CW operation on 865 MHz heater voltage is reduced 15%. Inquire for voltage recommended for other UHF conditions.

4CX600F TYPICAL OPERATION [2]

Frequency	432	865	MHz
Plate Voltage	1830	2000	Vdc
Screen Voltage	300	300	Vdc
Grid Voltage	-54	-53	Vdc
Plate Current	600	600	mAdc
Screen Current [1]	7.5	8	mAdc
Grid Current [1]	12	-1.0	mAdc
Zero-Signal dc Plate Current [1]	20	15	mAdc
Measured Driving Power [1]	25	52	W
Plate Input Power	1100	1200	W
Plate Dissipation	350	550	W
Useful Output Power	700	585	W
Heater Voltage [3]	22.0	22.0	V
Gain	15.0	10.4	db
Efficiency	65	48	%
Bandwidth(3db)output circuit	10.7	13.5	MHz

RADIO-FREQUENCY POWER AMPLIFIER
Class-B, Television Service (Frequencies to 890 MHz)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2500	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC PLATE CURRENT	0.6	AMPERE
PLATE DISSIPATION	600	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	3	WATTS
DC GRID VOLTAGE	-150	VOLTS

TYPICAL OPERATION (865 MHz)
Grid driven, neutralized coaxial cavity, grounded screen. Rf grounded cathode, single tuned input and output circuits. Output circuit efficiency 80%.

Plate Voltage	2000	Vdc
Screen voltage	300	Vdc
Grid voltage	-54	Vdc
Heater voltage (See note 3 page 2)		
Bandwidth at 3 db points	9	MHz
During Sync-Pulse		
dc Plate Current	600	mAdc
Pulse Screen Current 1	8	mAdc
Drive Power 1	52	W
Zero-Signal dc Plate Current	100	mAdc
Plate Dissipation	550	W
Useful Power Output	585	W
Black Level:		
dc Plate Current	450	mAdc
Drive Power 1	25	W
Zero-Signal dc Plate Current	100	mAdc
Plate Dissipation	550	W
Useful Power Output	350	W

1. Approximate

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
4CX600B			
Heater: Current at 6.0 volts	4.0	4.7	A
Cathode Warmup Time	180	--	sec.
4CX600F			
Heater: Current at 26.5 volts	0.85	1.25	A
Cathode Warmup Time	180	--	sec.
Interelectrode Capacitances 1 (grounded cathode connection)			
Input	42	48	pF
Output	5.3	6.3	pF
Feedback	---	0.2	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CX600B and 4CX600F may be mounted in any position. No socket is required. The tube may be mounted directly on the SK-680 Screen Bypass Capacitor which in turn is mounted to the chassis with four screws. The chassis thickness should be 0.062 inches to insure adequate space for connections to the base of the tube and care should be exercised to insure a flat mounting surface to minimize cathode lead inductance.

COOLING - Sufficient forced-air cooling must be provided to maintain the anode core and seal temperatures below 250°C. The tabulation (page 4) lists the minimum cooling requirements at sea level and 10,000 feet with 50°C ambient air. At VHF and UHF, additional cooling air will be required due to circuit loss, a portion of which is chargeable to the tube.

Air cooling of the tube base is required. 10 CFM minimum should be directed straight up toward the center of tube base from a duct or blower, not more than 2-1/2 inches from the tube.

PLATE DISSIPATION (WATTS)	SEA LEVEL		10,000 FEET	
	AIR FLOW (CFM)	STATIC PRESSURE (W.C.)	AIR FLOW (CFM)	STATIC PRESSURE (W.C.)
300	5.5	0.14	8.0	0.20
450	11.4	0.47	16.6	0.68
600	14.1	0.65	20.6	0.94

The following diagram illustrates a typical cooling installation.

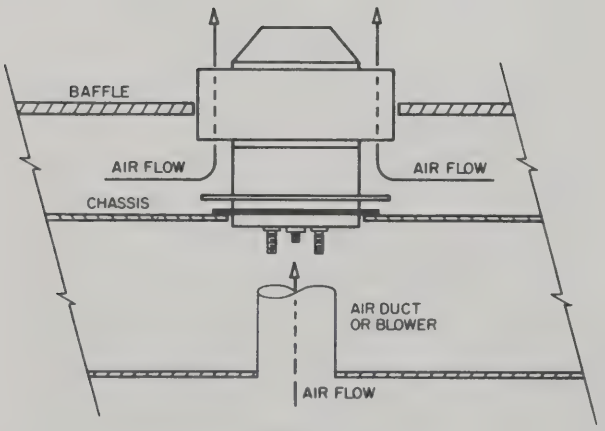


FIG. 1

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be bome in mind that operating temperature is the sole criterion of cooling effectiveness.

ELECTRICAL

HEATER - The rated heater voltage is 6.0 volts for the 4CX600B and 26.5 volts for the 4CX600F. The voltage, as measured at the tube, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above the rated value. (See note 3 page 2).

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than three minutes before current is drawn from the cathode. Tube operation will stabilize after a period of approximately five minutes from a cold start.

GRID OPERATION - The 4CX600B and 4CX600F control grid has a maximum dissipation of 3.0 watts and precautions should be observed to avoid exceeding this rating. Derating of the control grid dissipation will be necessary if the base flange temperature exceeds 150°C.

The 4CX600B and 4CX600F have four threaded grid pins on the base of the tube. These pins can be used separately or in parallel to control the amount of grid lead inductance to suit the requirements of the circuit. The grid lead inductance for one pin is 2.4 nanohenries.

Caution should be excercised when tightening the nuts on the control grid pins. Maximum torque of three inch-pounds is sufficient for good electrical connection and should not be exceeded due to possible damage to the vacuum seal.

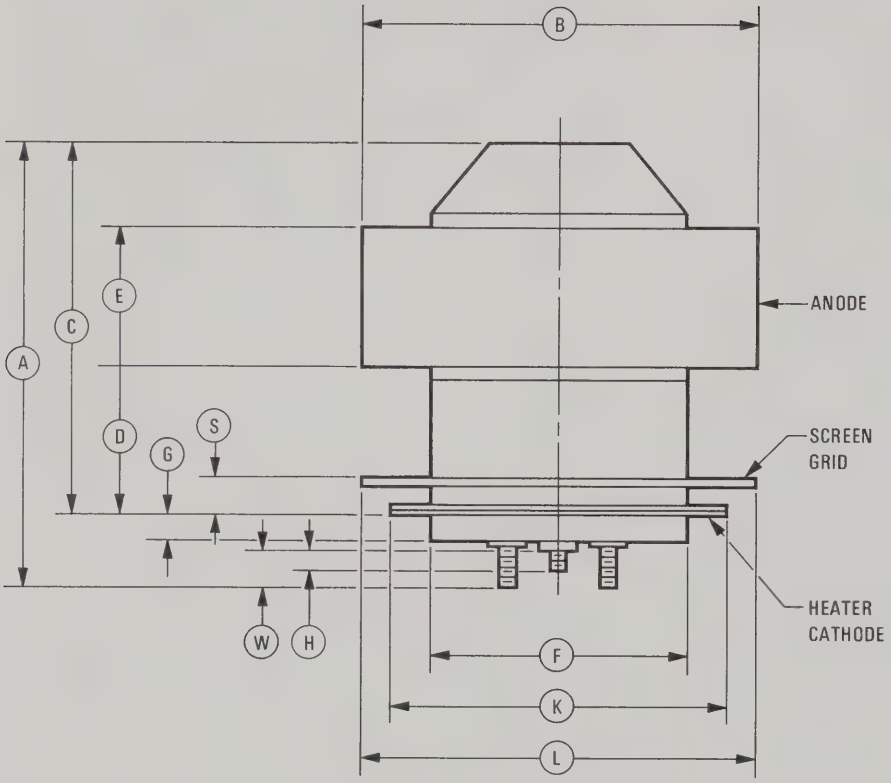
SCREEN OPERATION - The maximum rated screen dissipation for the 4CX600B and 4CX600F is 15 watts.

Under certain operating conditions the screen current of a tetrode may reverse as indicated on the screen current meter. This condition is the result of secondary emission from the screen and is normal for a power tetrode. If the impedance of the screen power supply is high, negative screen current will cause the screen voltage to approach the anode voltage, and the results will be a runaway condition which could lead to a catastrophic failure. This condition can be avoided if sufficient bleeder current is drawn from the screen supply by an appropriate bleeder or regulator tube. The recommended bleeder current for the 4CX600B and 4CX600F is 20 mA for each tube connected to a common screen power supply.

A low inductance screen bypass capacitor, Eimac SK-680, is available for the 4CX600B and 4CX600F. This capacitor is easily installed with six 0-80 screws. With the SK-680 capacitor installed, the screen self-resonant frequency of the 4CX600B or 4CX600F is in excess of 900 MHz.

PLATE OPERATION - The maximum rated plate dissipation power for the 4CX600B and 4CX600F is 600 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded. Connection to the anode is accomplished by a clamp around the anode.

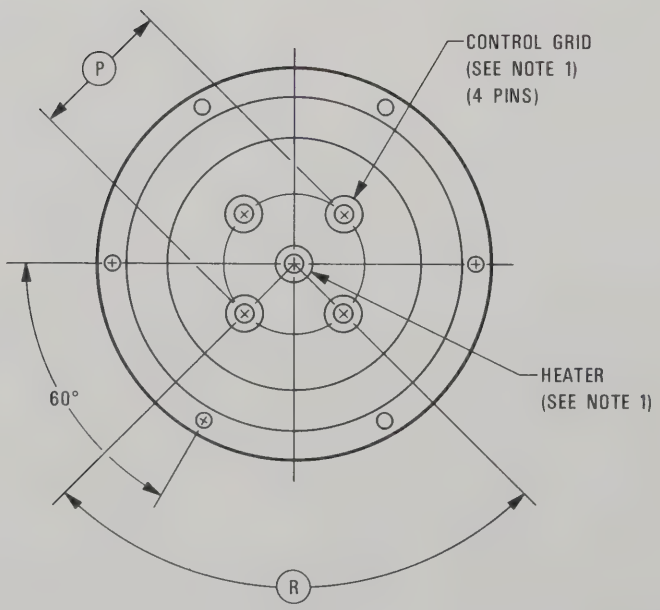
SPECIAL APPLICATIONS - If it is desired to operate the tube under conditions different from those given here, contact the Power Grid Division, EIMAC Division of Varian, San Carlos, California, 94070, for information and recommendations.

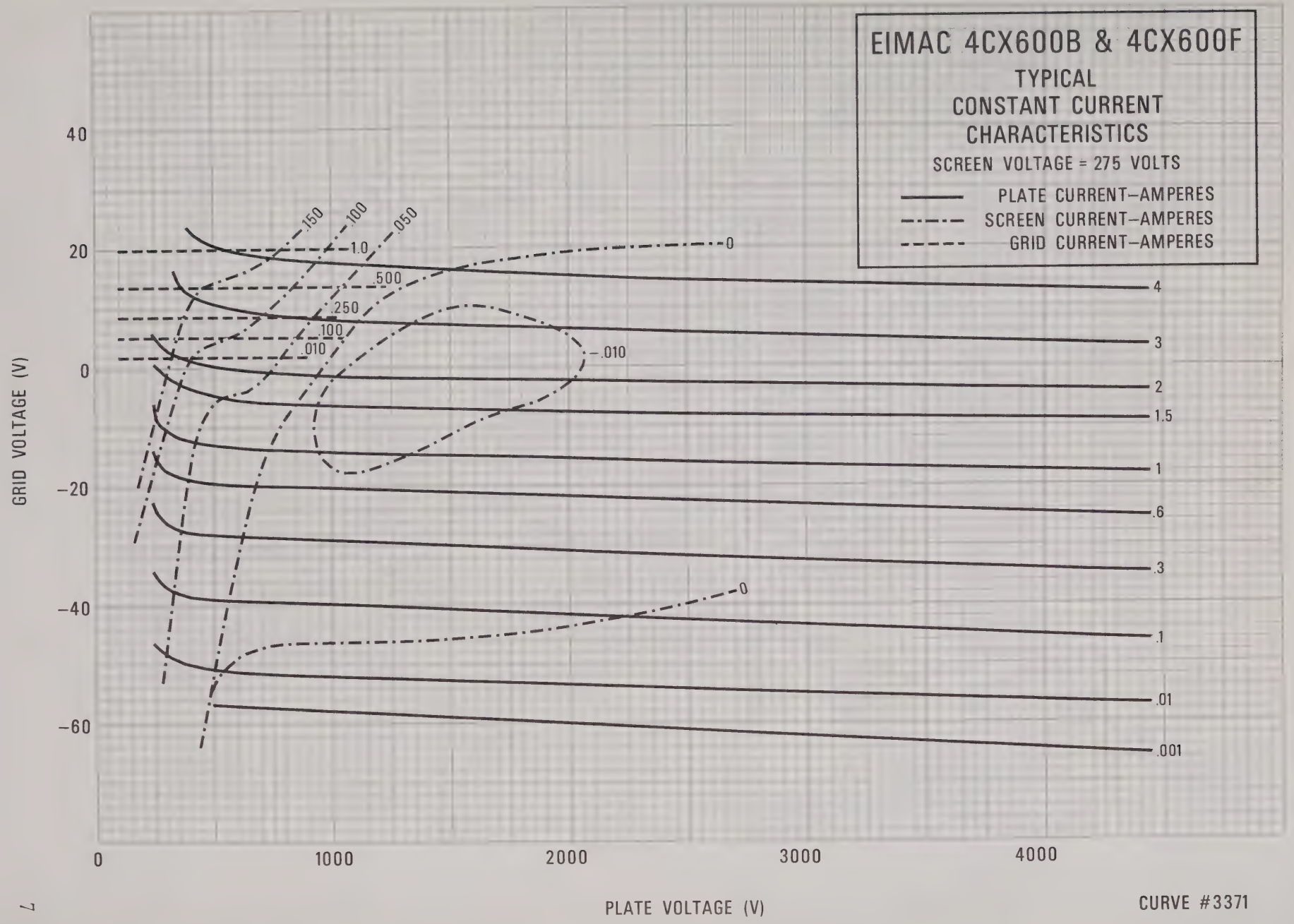


DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	--	2.450	--	62.23
B	2.040	2.080	51.82	52.83
C	1.825	1.975	46.35	50.16
D	.675	.810	17.14	20.57
E	.720	.800	18.29	20.32
F	1.305	1.325	33.15	33.65
G	.130	.155	3.30	3.94
H	.130	.180	3.30	4.57
K	1.710	1.750	43.43	44.45
L	1.930	2.025	49.02	51.43
P	.550	.600	13.97	15.24
R	88°	92°	88°	92°
S	.180	.210	4.57	5.33
W	.250	.300	6.35	7.62

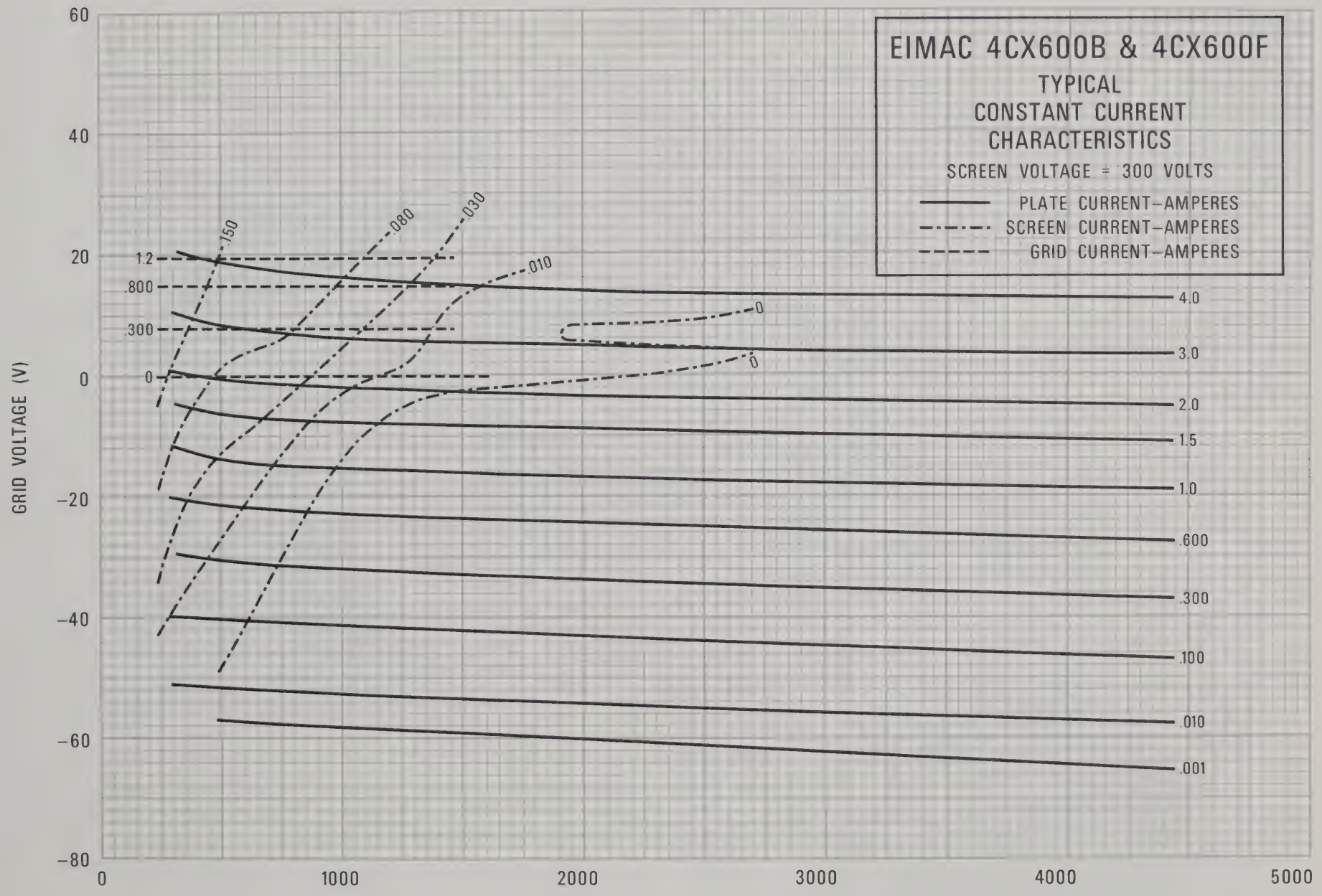
NOTES:

1. 2-56 UNC-2A
2. REF. DIM. ARE FOR INFO. ONLY AND ARE NOT REQ'D. FOR INSPECTION PURPOSES.




EIMAC 4CX600B & 4CX600F
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 275 VOLTS
PLATE CURRENT–AMPERES
SCREEN CURRENT–AMPERES
GRID CURRENT–AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (V)
40
20
0
−20
−40
−60
0
1000
2000
3000
4000
4
3
2
1.5
1
.6
.3
.1
.01
.001
1.0
.500
.250
.100
.010
.150
.100
.050
0
.010
0

CURVE #3371


EIMAC 4CX600B & 4CX600F
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 300 VOLTS
PLATE CURRENT–AMPERES
SCREEN CURRENT–AMPERES
GRID CURRENT–AMPERES
GRID VOLTAGE (V)
60
40
20
0
−20
−40
−60
−80
0
1000
2000
3000
4000
5000
PLATE VOLTAGE (V)
1.2
.800
.300
0
.150
.080
.030
.010
0
0
4.0
3.0
2.0
1.5
1.0
.600
.300
.100
.010
.001

CURVE #3988

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8168
4CX1000A
CERAMIC POWER TETRODE

The EIMAC 8168/4CX1000A is a ceramic/metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 rf linear-amplifier or audio-amplifier applications where its high gain may be used to advantage. At its rated maximum plate voltage of 3000 volts, it is capable of producing 1630 watts of peak-envelope output power. Two 8168/4CX1000As operating in Class-AB_1 will produce 3260 watts of audio power.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	9.0	A
Transconductance (Average):		
I_b = 1.0 Adc	37,000	μmhos
Direct Interelectrode Capacitances (grounded cathode)[2]		
Input	81	pF
Output	11.8	pF
Feedback	0.015	pF
Direct Interelectrode Capacitances (grounded grid and screen)[2]		
Input	35.5	pF
Output	12	pF
Feedback	0.004	pF
Frequency of Maximum Rating:		
CW	110	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	4.80 in; 122 mm
Diameter	3.37 in; 85.5 mm
Net Weight	27 oz; 768 gm
Operating Position	Any

(Revised 5-1-70) © 1963, 1966, 1967 Varian

Printed in U.S.A.

Maximum Operating Temperature:
- Ceramic/Metal Seals . . . . . 250°C
- Anode Core . . . . . 250°C

Cooling . . . . . Forced Air
Base . . . . . Special, breechblock terminal surfaces
Recommended Socket . . . . . EIMAC SK-800 Series
Recommended Chimney . . . . . EIMAC SK-806 Series

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1000	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	0	WATT

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1 Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2000	2500	3000	Vdc
Screen Voltage	325	325	325	Vdc
Grid Voltage[1]	-60	-60	-60	Vdc
Zero-Signal Plate Current	250	250	250	mAdc
Single Tone Plate Current	890	885	875	mAdc
Two-Tone Plate Current	645	650	635	mAdc
Zero-Signal Screen Current	8	6	5	mAdc
Single-Tone Screen Current[2]	35	35	35	mAdc
Two-Tone Screen Current[2]	10	8	8	mAdc
Plate Output Power	930	1300	1630	W

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_1, Grid Driven(Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1000	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	0	WATT

TYPICAL OPERATION (Two Tubes)

Plate Voltage	2000	2500	3000	Vdc
Screen Voltage	325	325	325	Vdc
Grid Voltage[1,2]	-60	-60	-60	Vdc
Zero-Signal Plate Current	500	500	500	mAdc
Max Signal Plate Current	1.78	1.77	1.75	Adc
Zero-Signal Screen Current[1]	16	12	10	mAdc
Max Signal Screen Current[1]	70	70	70	mAdc
Plate Output Power	1860	2600	3260	W
Load Resistance (plate to plate)	2040	2850	3860	Ω

1. Approximate value.
2. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	8.1	9.9	A
Cathode Warmup Time	3	---	min.
Interelectrode Capacitances[1] (grounded cathode connection)			
Input	75	88	pF
Output	10.8	12.8	pF
Feedback	---	0.022	pF

1. In shielded fixture

APPLICATION

MECHANICAL

COOLING - Sufficient cooling must be provided for the anode and ceramic/metal seals to maintain operating temperatures below the rated maximum values:

Ceramic/Metal Seals	250°C
Anode Core	250° C

A flow rate of 25 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 25 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.2 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes and at VHF increased air flow will be required. For example, at an altitube of 10,000 feet, a flow rate of 37 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.3 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude.*

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

The 4CX1000A is tested for vibration (noise) from 10 Hz to 500 Hz. Vibration level is 10 G units peak 28 Hz to 500 Hz. Below 28 Hz vibration double amplitude is .25 inch.

The 4CX1000A is tested for shock, 50 G, 11 ms, three axes, after which the tube must be within specification for grid bias voltage and gas current.

ELECTRICAL

HEATER - The rated heater voltage for the 4CX1000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

GRID OPERATION - The grid dissipation rating of the 4CX1000A is zero watts. The design features which make the tube capable

of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than five-milliamperes as read on a five-milliampere meter may be permitted to flow for peak-signal monitoring purposes.

SCREEN OPERATION - Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1000A is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

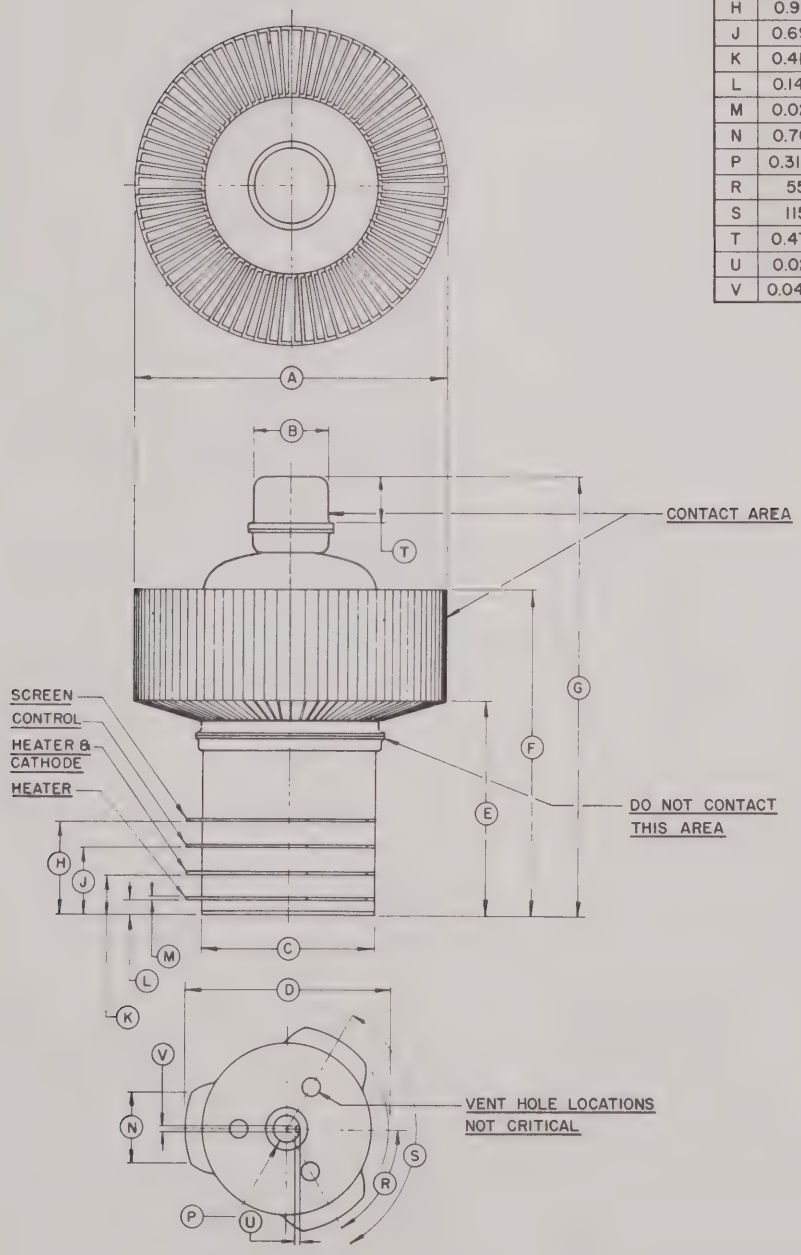
The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

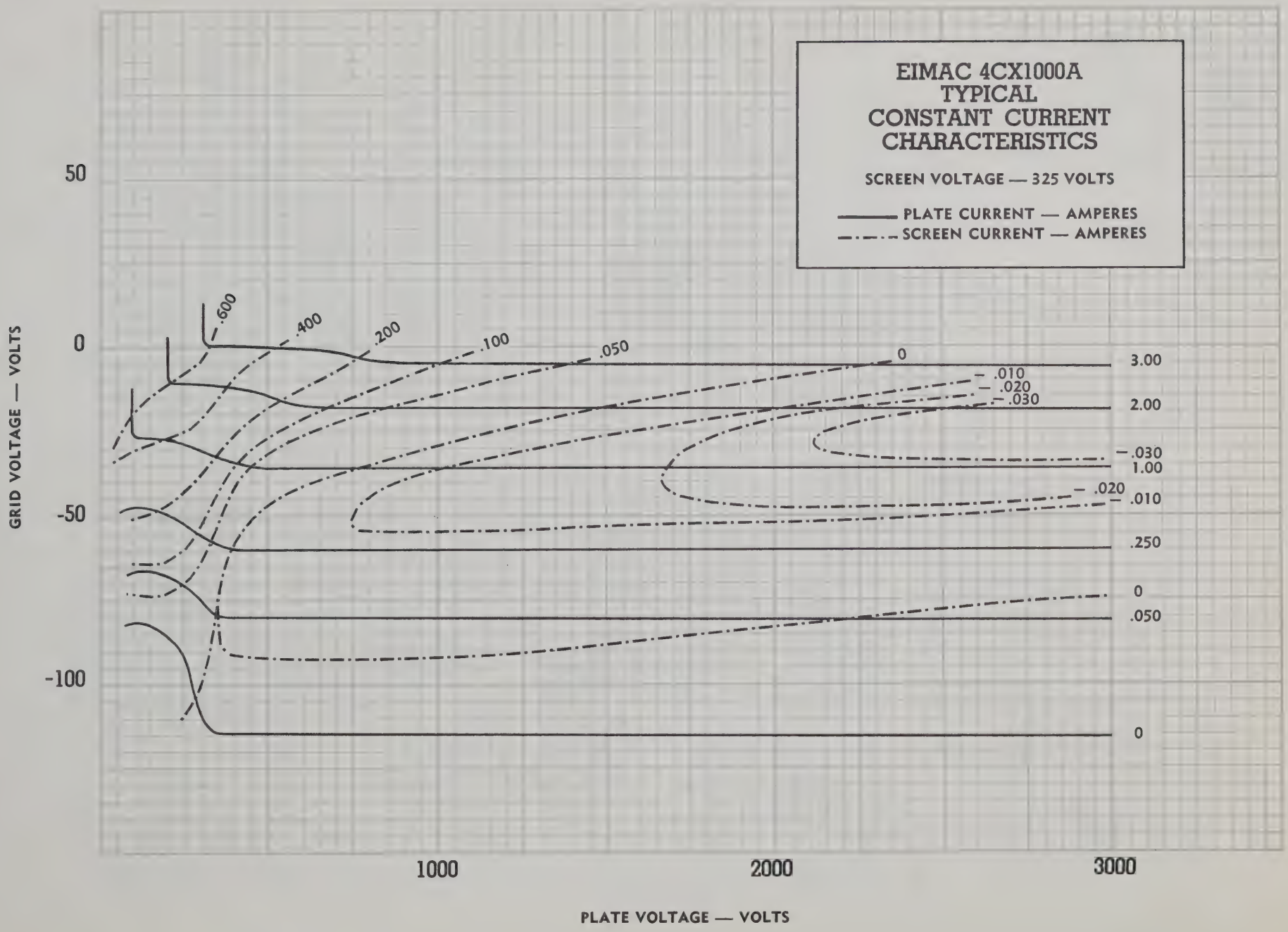
PLATE OPERATION - The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions different from those given here, write to the Power Grid Tube Marketing Department, EIMAC Division of Varian, San Carlos, California 94070, for information and recommendations.

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	3.335	3.365	84.71	85.47
B	0.807	0.817	20.50	20.75
C	1.870	1.900	47.50	48.26
D	2.250D	2.300D	57.15D	58.42D
E	2.195	2.380	55.75	60.45
F	3.410	3.550	86.61	90.17
G	4.600	4.800	116.84	121.92
H	0.965	0.988	24.51	25.10
J	0.690	0.710	17.53	18.03
K	0.415	0.435	10.54	11.05
L	0.140	0.165	3.56	4.19
M	0.020	0.030	0.51	0.76
N	0.700	0.800	17.78	20.32
P	0.314D	0.326D	7.98D	8.28D
R	55°	65°	55°	65°
S	115°	125°	115°	125°
T	0.470	0.530	11.94	13.46
U	0.025	0.048	0.63	1.22
V	0.045D	0.070D	1.14	1.78




EIMAC 4CX1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID VOLTAGE — VOLTS
50
0
-50
-100
1000
2000
3000
PLATE VOLTAGE — VOLTS
.600
.400
.200
.100
.050
0
.010
.020
.030
3.00
2.00
.030
1.00
.020
.010
.250
0
.050
0

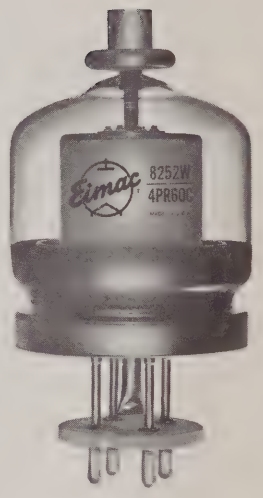
TECHNICAL DATA

8252W
4PR60C

PULSE MODULATOR TETRODE

The EIMAC 8252W/4PR60C is a high-vacuum tetrode intended for pulse-modulator service in circuits employing inductive or resistive loads. This tube unilaterally replaces the 715C and the 5D21 and supersedes the 8252/4PR60B. The internal structure of the tube has been strengthened to minimize the effects of shock and vibration.

The 8252W/4PR60C has a maximum plate dissipation rating of 60 watts, is cooled by radiation and convection, and delivers pulse output power in the region of 300 kilowatts with less than one kilowatt of pulse driving power.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-coated, Unipotential		
Heater Voltage	26.0	V
Heater Current	2.1	A
Cathode Heating Time	3	Min.
Direct Interelectrode Capacitances[2]		
Cin	43	pF
Cout	8.5	pF
Cgp	1.5	pF

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191A.

MECHANICAL

Environmental Capability	See Application Note
Base	Fits E.F. Johnson Co. Socket Number 122-234 or equivalent
Mounting Position	Any
Cooling	Radiation and Convection
Recommended Heat Dissipating Plate Connector	EIMAC HR-8
Maximum Seal and Envelope Temperatures	200°C
Maximum Over-All Dimensions	
Length	6.000 in; 152.4 mm
Diameter	3.063 in; 77.9 mm
Net Weight	12 oz; 0.34 kg
Shipping Weight	2.5 lb; 1.14 kg

(Revised 6-30-71) © 1962, 1966, 1971 Varian

Printed in U.S.A.

PULSE MODULATOR OR SWITCH TUBE SERVICE

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	20 KILOVOLTS
DC SCREEN VOLTAGE	1.5 KILOVOLTS
DC GRID VOLTAGE[2]	-1.0 KILOVOLT
PEAK POSITIVE GRID VOLTAGE	300 VOLTS
PEAK PLATE CURRENT	18 AMPERES
PEAK POSITIVE PLATE VOLTAGE	25 KILOVOLTS
PLATE DISSIPATION(Average)	60 WATTS
SCREEN DISSIPATION (Average)	8 WATTS
GRID DISSIPATION(Average)	1 WATT
DUTY	See chart page 6

1. Approximate value.

TYPICAL OPERATION

Pulse Modulator (Per Tube)			
DC Plate Voltage	16.0	20.0	kVdc
Pulse Plate Current	10.0	18.0	a
DC Screen Voltage	1.25	1.25	kVdc
Pulse Screen Current[1]	1.8	2.7	a
DC Grid Voltage	-550	-600	Vdc
Pulse Grid Current[1]	0.20	0.75	a
Pulse Positive Grid Voltage	30	150	v
Duty	0.0025	.001	
Pulse Duration	5	2	μs
Peak Positive Plate Voltage	25	25	kv
Pulse Input Power	160	360	kw
Pulse Output Power	150	337	kw
Pulse Output Voltage	15.0	18.75	kv

2. The effective grid-circuit resistance must not exceed 100,000 ohms.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current at E_f = 27.0 volts	1.95	2.35	A
Interelectrode Capacitances[1] (grounded cathode connection)			
Cin	35	50	pF
Cout	6.0	11	pF
Cgp	---	2.0	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4PR60C may be mounted and operated in any position. A flexible connecting strap should be provided between the plate terminal and the external plate circuit.

If environmental stress, such as shock or vibration is expected, the tube must be clamped into position by means of clamps on the metal skirt. Such clamps must be shaped to fit the contour of the skirt and must be fastened to the tube before being tightened to the chassis in order that no distorting force will be applied. No lateral pressure or clamping action should be applied to the base pins or to any part of the tube other than the skirt. The skirt is internally connected to the cathode.

COOLING - Adequate ventilation must be provided so that seal and/or envelope temperatures do not exceed 200°C under any operating or standby condition. When the 4PR60C is operated where air circulation is restricted, these temperatures can easily reach 225°C or more which will accelerate seal deterioration and cause early tube failure.

Adequate control of the base temperature, in particular, is necessary. Envelope and plate-seal temperatures do not ordinarily require special attention provided that an HR-8 heat dissipating plate connector is used. However, each individual application of the 4PR60C should be carefully evaluated to assure safe operating temperatures. A blower is usually required only when normal air circulation is restricted, when the ambient temperature exceeds 25°C, when the altitude is other than sea level, or when a combination of these factors exists.

ELECTRICAL

HEATER OPERATION - The heater voltage, as measured directly at the heater pins, should be maintained at the rated value of 26.0 volts. Maximum variations in heater voltage must be kept within the range of 23.4 to 28.6 volts. Where consistent performance and long tube life are factors, the heater voltage must be kept within range of 24.7 to 27.3 volts. The peak pulse-emission capability of the cathode may be impaired at low

heater voltages, and high heater voltages contribute to short tube life.

A heater noise test is conducted periodically on 4PR60C samples. This test insures that the heater/cathode assembly will not generate excessive rf noise during vibration over the frequency range of 10 to 50 cps.

A 500-hour heater cycling test is also conducted periodically on 4PR60C samples. This test consists of at least 1000 complete on-off cycles and insures that grid-to-cathode shorts will not occur as a result of cumulative hysteresis effects upon mechanical joints in the cathode assembly.

CATHODE OPERATION - It is essential that the minimum cathode heating time of three minutes be observed prior to the flow of cathode current. Conservative design for reliable tube operation in pulse circuits dictates the use of five minutes minimum heating time.

The "Cathode Current Derating Chart" depicts the current capabilities of the 4PR60C cathode at various pulse durations and duty factors. To use this chart, enter with pulse duration and note the intersection with desired pulse *cathode* current (the total of plate, screen, and grid currents during particular pulse condition). At this intersection read off values of maximum duty and/or pulse repetition rate.

Under a given set of operating conditions, element dissipations may limit the maximum permissible duty to a value less than that which cathode considerations would dictate. When this occurs, it will usually be found that screen dissipation is the limiting factor under low tube-voltage-drop conditions and that plate dissipation limits the maximum duty under high tube-voltage-drop conditions.

CONTROL-GRID OPERATION - The average power dissipated by the control grid of the 4PR60C must not exceed one watt. Control-grid dissipation is not usually a limiting factor with this tube, but can be computed as the product of pulse grid current, pulse positive grid voltage, and duty factor. Similarly, pulse driving power is pulse grid current times pulse grid voltage swing (bias voltage plus positive grid voltage).

SCREEN-GRID OPERATION - The average power dissipated by the screen of the 4PR60C must not exceed eight watts. Screen dissipation is the product of dc screen voltage, pulse screen current, and duty factor. Excessive screen dissipation is likely to occur under conditions of low tube-voltage drop during conduction. This condition can be relieved by using a lower plate load resistance which will cause higher tube-voltage drop during conduction.

A bleeder resistance designed to draw at least 10 milliamperes of current should be connected directly from screen to cathode of the 4PR60C. This bleeder resistance will insure that only a positive current load is presented to the screen supply.

PLATE OPERATION - The plate of the 4PR60C is radiation cooled and is rated at 60 watts maximum dissipation. Average plate dissipation must not exceed 60 watts. The 4PR60C should not be operated without a heat-dissipating plate connector such as the recommended EIMAC HR-8.

Average plate dissipation may be calculated as the product of pulse plate current, pulse tube-voltage drop, and duty factor. Excessive average plate dissipation is likely to occur at high values of pulse tube-voltage drop. The calculated value of plate dissipation may be well below 60 watts in a given case, but excessive dissipation may result if pulse rise and fall times are appreciable compared to pulse duration. This excessive plate dissipation occurs because long rise and fall times slow down the plate voltage swing and allow plate current to flow for longer periods in the high voltage-drop region.

The plate-supply voltage for the 4PR60C should not exceed 20 kilovolts. In circuits employing inductive loading, the peak instantaneous plate voltage should not exceed 25 kilovolts.

CAUTION-HIGH VOLTAGE - Operating voltage for the 4PR60C can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SHOCK/VIBRATION - The internal structure of the 4PR60C has been reinforced to minimize the effects of shock and vibration in the grid-cathode section of the tube. When environmental stress is expected, proper mounting is extremely important (see MOUNTING).

Production samples are periodically tested for ability to survive 50 G, 11 millisecond shock im-

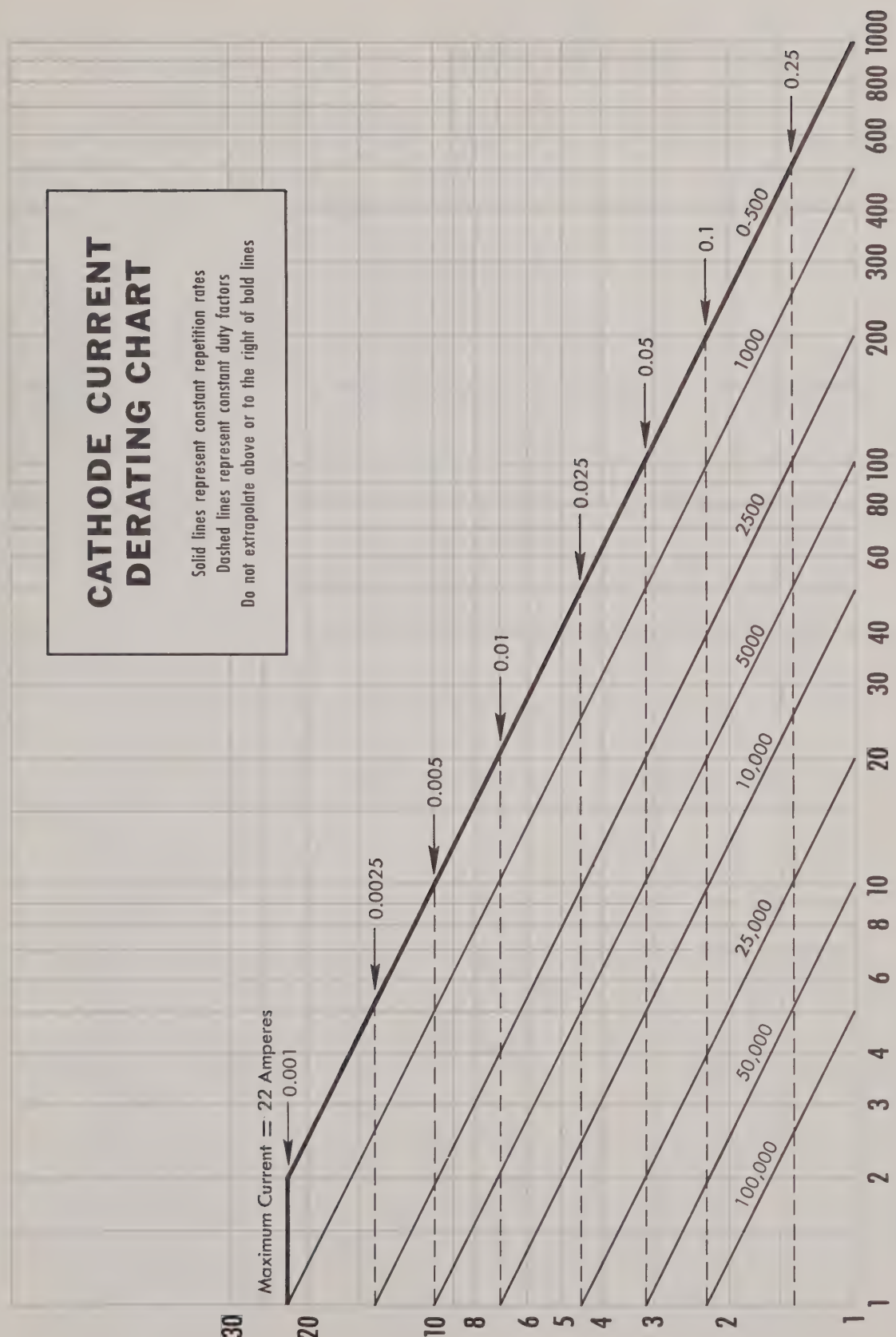
pact, and vibration at a fixed double-amplitude of 0.08 inch over the range of 10 to 50 Hz and 10 G of acceleration over the range of 50 to 200 Hz.

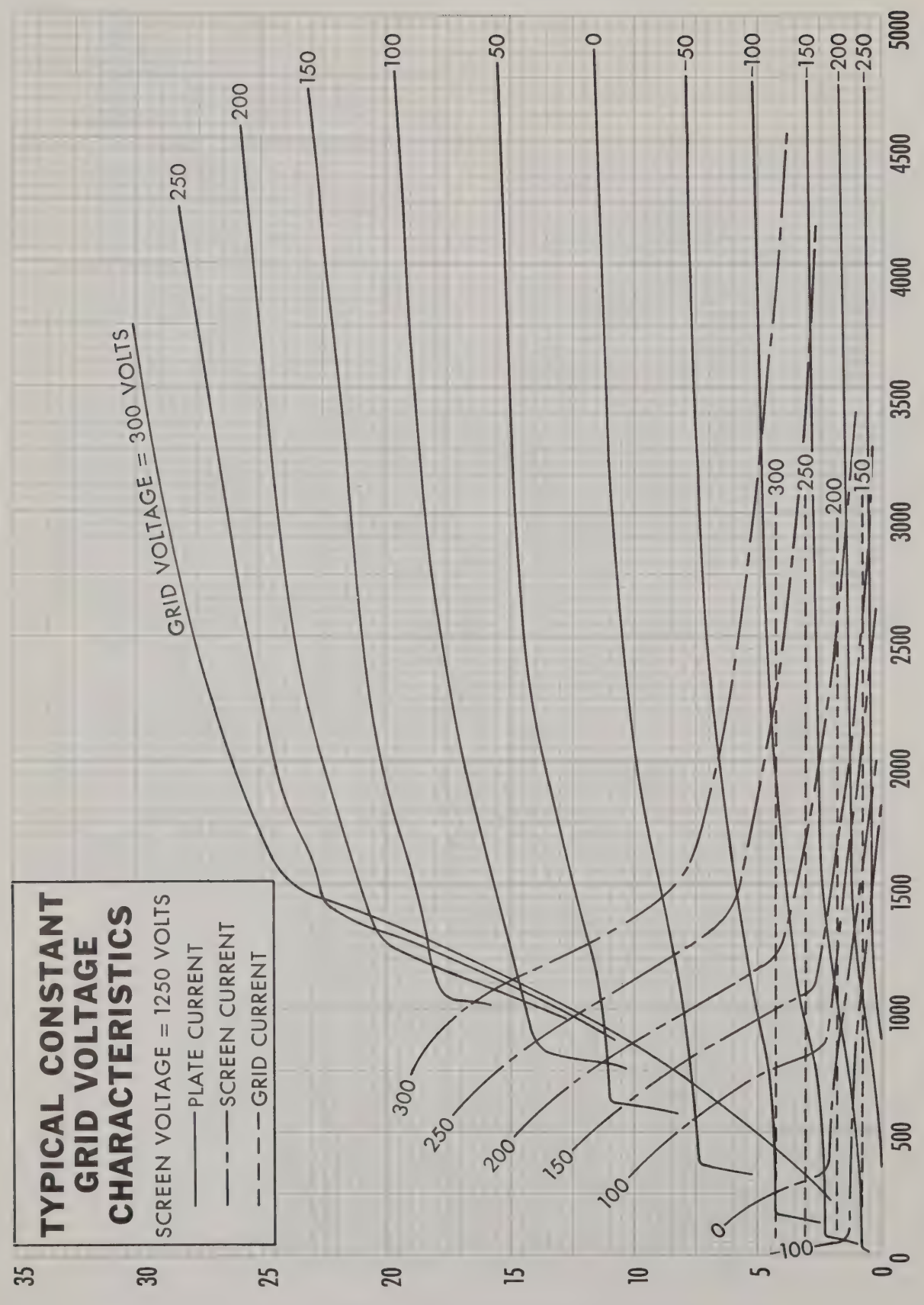
X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4PR60C, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

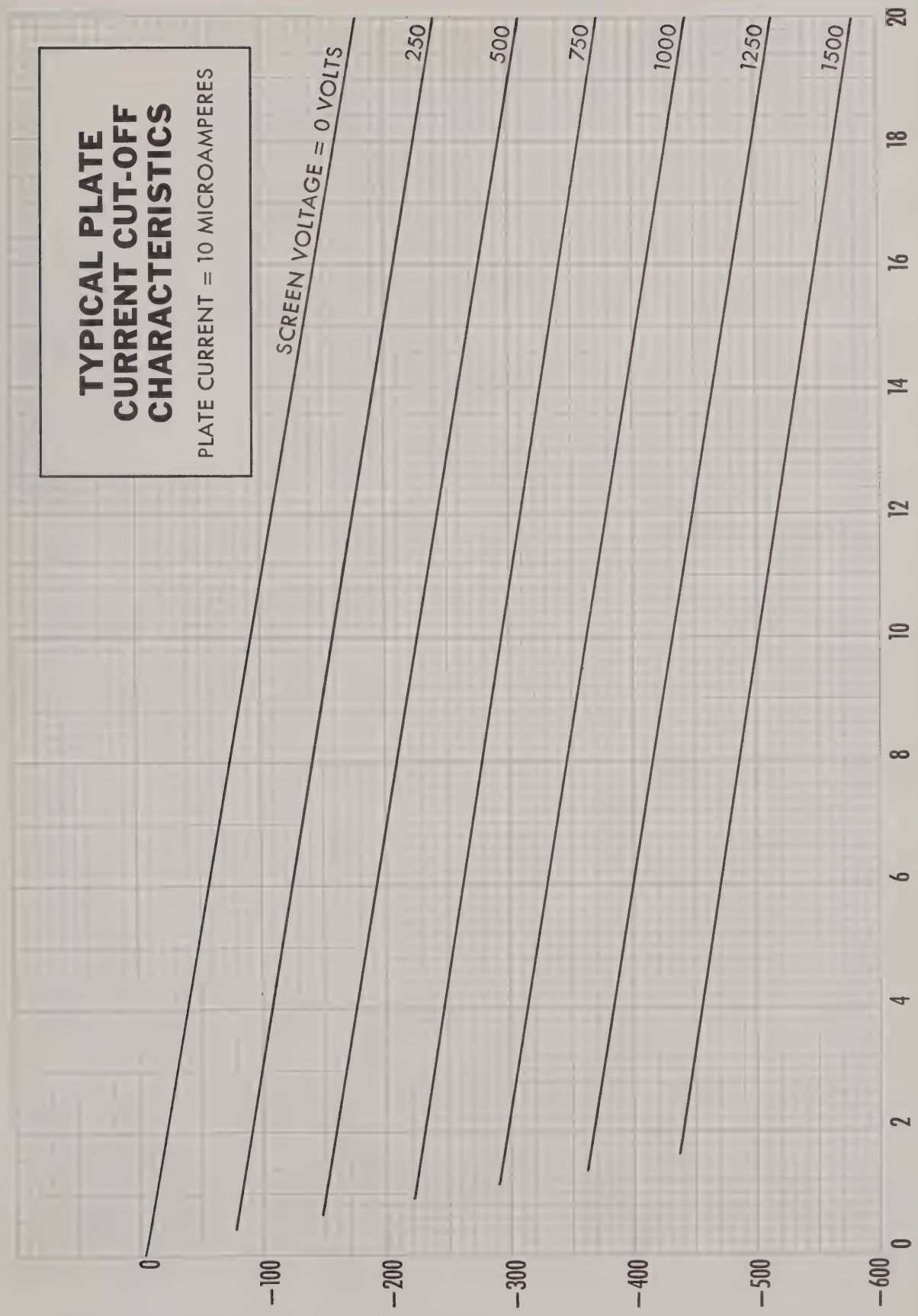
Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

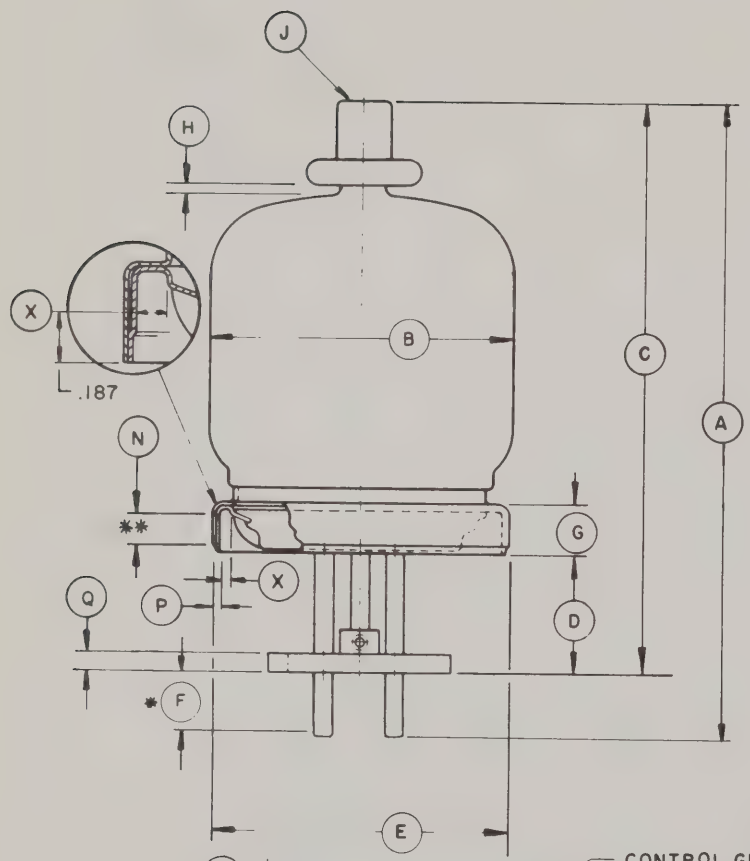
CAUTION-GLASS IMPLOSION - The EIMAC 4PR60C is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

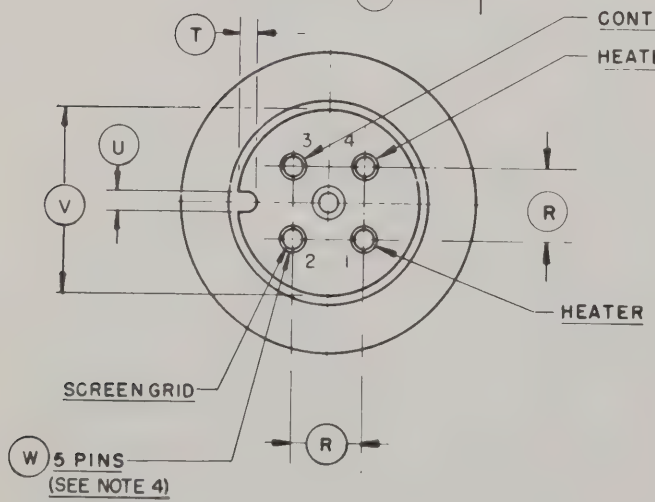
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


CATHODE CURRENT
DERATING CHART
Solid lines represent constant repetition rates
Dashed lines represent constant duty factors
Do not extrapolate above or to the right of bold lines
Maximum Current = 22 Amperes
0.001
0.0025
0.005
0.01
0.025
0.05
0.1
0.25
0.500
1000
2500
5000
10,000
25,000
50,000
100,000
PULSE CATHODE CURRENT – AMPERES
30
20
10
8
6
5
4
3
2
1
1
2
3
4
6
8
10
20
30
40
60
80
100
200
300
400
600
800
1000
PULSE DURATION – MICROSECONDS


TYPICAL CONSTANT GRID VOLTAGE CHARACTERISTICS
SCREEN VOLTAGE = 1250 VOLTS
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
GRID VOLTAGE = 300 VOLTS
250
200
150
100
50
0
-50
-100
-150
-200
-250
300
250
200
150
100
0
-100
CURRENT—AMPERES
PLATE VOLTAGE—VOLTS
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5
10
15
20
25
30
35


TYPICAL PLATE CURRENT CUT-OFF CHARACTERISTICS
PLATE CURRENT = 10 MICROAMPERES
SCREEN VOLTAGE = 0 VOLTS
250
500
750
1000
1250
1500
0
−100
−200
−300
−400
−500
−600
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE–VOLTS
PLATE VOLTAGE–KILOVOLTS





DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	5.750	6.000	--	146.10	152.40	--
B	--	3.063	--	--	77.80	--
C	5.344	5.594	--	135.7	142.1	--
D	1.125	1.250	--	28.57	31.75	--
E	2.885	2.905	--	73.28	73.79	--
F	0.328	--	--	8.33	--	--
G	0.438	0.500	--	11.13	12.70	--
H	0.016	--	--	0.41	--	--
J	CAP: C1-41 (JEDEC DESIGNATION)					
N	0.250	--	--	6.35	--	--
P	0.043	0.057	--	1.09	1.45	--
Q	--	--	0.188	--	4.77	--
R	--	--	0.687	--	17.45	--
T	0.171	0.203	--	4.34	5.16	--
U	0.171	0.203	--	4.34	5.16	--
V	1.788	1.813	--	45.42	46.05	--
W	0.183	0.191	--	4.65	4.85	--
X	0.157	--	--	3.99	--	--

NOTES:

1. DIMENSIONS IN INCHES.
2. (*) CONTACT AREA.
3. (**) DEFINES CYLINDRICAL AREA AVAILABLE FOR CLAMPING WHICH MUST NOT BE DISTORTED BY CLAMPING ACTION.
4. THE BASE PINS SHALL BE CAPABLE OF ENTERING A GAUGE 1/4 INCH THICK HAVING FOUR .214" DIA. HOLES LOCATED ON 11/16 CENTERS AND A CENTER HOLE .250 DIA

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

TENTATIVE DATA

8321
4CX350A
8322
4CX350F

RADIAL-BEAM
POWER TETRODES



The Eimac 8321/4CX350A and 8322/4CX350F are compact radial beam tetrodes with maximum plate dissipation of 350 watts and are intended for Class-AB, audio or rf amplifier service. These tubes are externally identical to the 4CX250B but contain rugged internal construction features. Amplification factor and cathode area have been increased over the 4CX250B to give higher transconductance and figure or merit.

The 8321/4CX350A and 8322/4CX350F differ only in heater voltage and current; the 8321/4CX350A is used at 6.0 volts while the 8322/4CX350F is rated at 26.5 volts. Both types are of ceramic and metal construction and are recommended for new equipment design.

GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-Coated, Unipotential				
	Heating Time	30		60	secs
	Cathode-to-Heater Potential			±150	volts
Heater:	4CX350A Voltage		6.0		volts
	4CX350A Current	2.9		3.6	amps
	4CX350F Voltage		26.5		volts
	4CX350F Current	0.66		0.81	amps

	Min.	Nom.	Max.	
Amplification Factor (Grid-to-Screen)		13		
Transconductance (I_b = 150 mA)		22,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	22.2		26.2	uuf
Output	5.0		6.0	uuf
Feedback			0.05	uuf
Direct Interelectrode Capacitances, Grounded Grid and Screen:				
Input	17.9		21.9	uuf
Output	5.0		6.0	uuf
Feedback			0.01	uuf
Frequency for Maximum Ratings			500	Mc

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250° C
Anode Core	250° C
Recommended Socket	Eimac SK-600 Series
Operating Position	Any
Maximum Dimensions:	
Height	2.464 inch
Seated Height	1.910 inch
Diameter	1.640 inch
Cooling	Forced air
Net Weight	4 ounces
Shipping Weight (approximate)	1.6 pounds

(Effective 10-12-62) Copyright 1962 by Eitel-McCullough, Inc.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

DC PLATE VOLTAGE	2000	MAX.	VOLTS
DC SCREEN VOLTAGE	400	MAX.	VOLTS
DC PLATE CURRENT	300	MAX.	MA
PLATE DISSIPATION	350	MAX.	WATTS
SCREEN DISSIPATION	8	MAX.	WATTS
GRID CURRENT	2	MAX.	MA

* Approximate values

[1] Adjust grid bias to obtain listed zero-signal plate current.

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

DC Plate Voltage	1000	1500	2000	volts
DC Screen Voltage	400	400	400	volts
DC Grid Voltage[1]	-24	-24	-24	volts
Zero-Signal DC Plate Current	200	200	200	mA
Max-Signal DC Plate Current	520	530	540	mA
Max-Signal DC Screen Current	-8	-10	-10	mA
Effective Load, Plate to Plate	2600	5000	7500	ohms
Peak AF Grid Input Voltage (per tube)*	21	21	21	volts
Driving Power	0	0	0	watts
Max-Signal Plate Input Power	560	800	1080	watts
Max-Signal Plate Output Power	190	400	600	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000	MAX.	VOLTS
DC SCREEN VOLTAGE	400	MAX.	VOLTS
DC PLATE CURRENT	300	MAX.	WATTS
PLATE DISSIPATION	350	MAX.	WATTS
SCREEN DISSIPATION	8	MAX.	WATTS
GRID CURRENT	2	MAX.	MA

* Approximate values.

[1] Adjust grid bias to obtain listed zero-signal plate current.

TYPICAL OPERATION (Frequencies up to 175 Mc, peak-envelope conditions except where noted)

DC Plate Voltage	1000	1500	2000	volts
DC Screen Voltage	400	400	400	volts
DC Grid Voltage[1]	-24	-24	-24	volts
Zero-Signal DC Plate Current	100	100	100	mA
Peak RF Grid Voltage*	21	21	21	volts
DC Plate Current	260	265	270	mA
DC Screen Current *	-4	-5	-5	mA
Plate Input Power	260	400	540	watts
Plate Output Power	95	200	300	watts
Two-Tone Average DC Plate Current	100	100	105	mA
Two-Tone Average DC Screen Current*	-7	-8	-8	mA
Resonant load Impedance	1300	2500	3750	ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance is made for circuit losses of any kind. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

MOUNTING — The 4CX350A and 4CX350F may be operated in any position. An Eimac Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen by-pass capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING — Sufficient cooling must be provided for the anode, base seals and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain seal temperatures at 225°C in 50°C ambient air are tabulated on page 3. These requirements apply when the Eimac SK-600 or SK-610 socket is used with the SK-606 chimney and air-flow in the base-to-anode direction.

At 500 mc or below, base-cooling air requirements are satisfied automatically when the tube is operated in an Eimac Air-System Socket and the recommended air-flow rates are used. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt, which might interfere with effective cooling.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown below, plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

MINIMUM COOLING AIR-FLOW REQUIREMENTS				
	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air-Flow (CFM)	Pressure Drop (Inches of water)	Air-Flow (CFM)	Pressure Drop (Inches of water)
250	5.3	0.6	7.7	0.85
300	6.5	0.9	9.5	1.25
350	7.8	1.2	1.2	1.9

If cooling methods other than forced air are used, if the recommended air-flow rates are not supplied or if there is any doubt that the cooling is adequate, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. One method of measuring the surface temperatures is by the use of a temperature-sensitive lacquer. When temperature-sensitive materials are used, extremely thin applications must be used to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

VIBRATION — These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments.

ELECTRICAL

HEATER — The rated heater voltages for the 4CX350A and 4CX350F are 6.0 volts and 26.5 volts respectively and these voltages should be maintained as closely as practicable. Short-time variations of the voltage of ±10% of the rated value will not damage the tube, but variations in performance must be expected. The heater voltage should be maintained within ±5% of its rated value to minimize variations in performance and to obtain maximum tube life.

CATHODE OPERATION — The cathode is internally connected to the four even-numbered base pins, and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

CONTROL-GRID OPERATION — The grid dissipation rating of the 4CX350A and 4CX350F is zero watt. The design features which make the tubes capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive grid operation. The grid current rating of 2.0 milliamperes allows the flow of positive grid current for peak-signal monitoring purposes.

SCREEN-GRID OPERATION — The maximum rated power dissipation for the screen grid is 8 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the d-c screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen can be provided by an overcurrent relay and by interlocking the screen supply so that the plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions, and produce negative current indications on the screen milliameter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind, so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

PLATE OPERATION — The maximum rated plate-dissipation power is 350 watts. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

At frequencies up to approximately 30 megacycles the top cap on the anode cooler may be used for a plate terminal. At higher frequencies a circular clamp or spring-finger collect encircling the cylindrical outer surface of the anode cooler should be used.

MULTIPLE OPERATION — Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube/s in the event that one tube should fail.

UHF OPERATION — The 4CX350A and 4CX350F are useful in the UHF region. UHF operation should be conducted with heavy plate loading, minimum bias and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

At frequencies above approximately 300 megacycles, transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input, the heater voltage should be reduced according to the table below:

Frequency, Mc	4CX350A	4CX350F
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Some of the added circuit loss observed in UHF operation is in the base insulator of the tube. It is sometimes necessary to use more than the recommended minimum air-flow rates to maintain safe operating base temperatures at UHF.

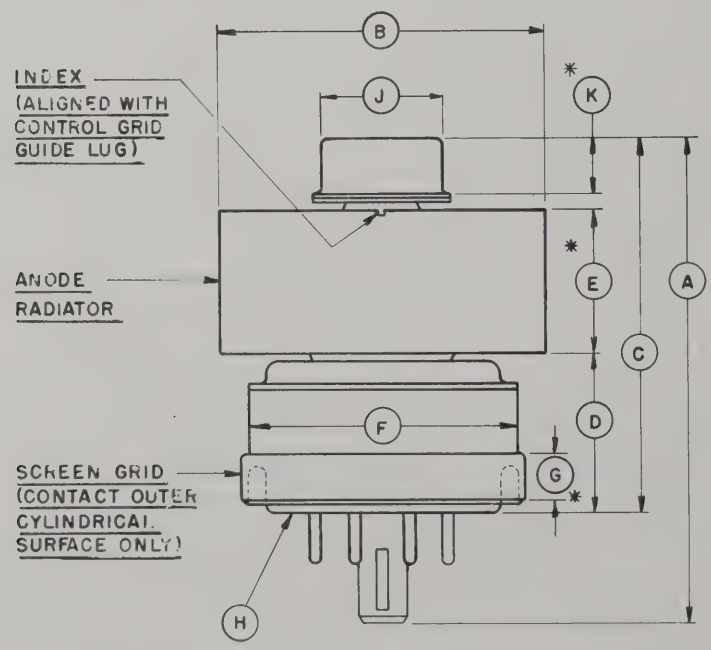
These tubes may be used in frequency multiplier applications. Such operation results in low plate efficiency and requires high driving voltages. If the frequency multiplier is used as an output power stage, it is preferable to operate the final tube as a frequency doubler rather than a frequency tripler.

SPECIAL APPLICATIONS — If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California for information and recommendations.

PIN NO. 1. SCREEN GRID
PIN NO. 2. CATHODE
PIN NO. 3. HEATER
PIN NO. 4. CATHODE
PIN NO. 5. I.C. DO NOT USE FOR EXTERNAL CONNECTION
PIN NO. 6. CATHODE
PIN NO. 7. HEATER
PIN NO. 8. CATHODE
CENTER PIN — CONTROL GRID

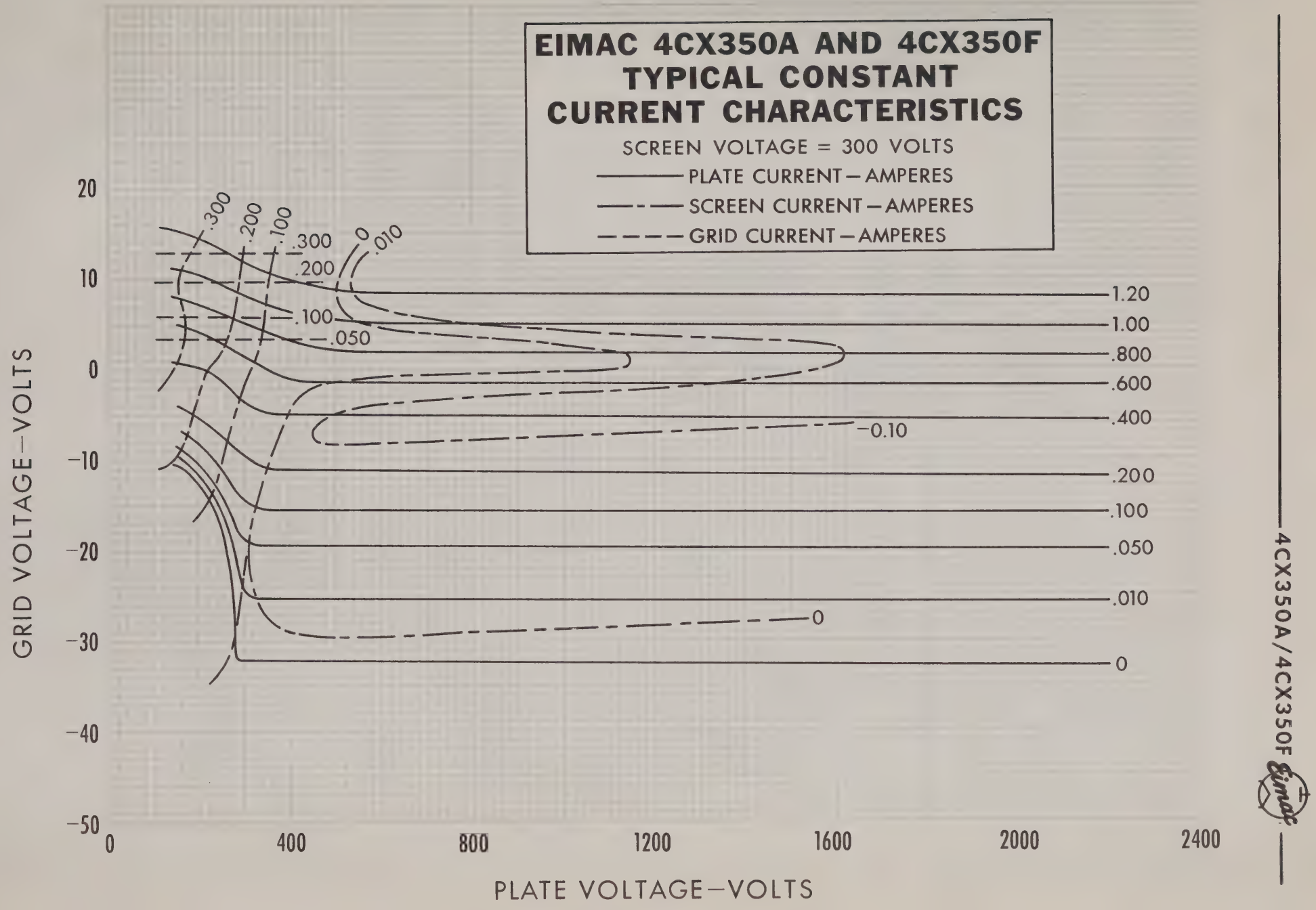
DIMENSIONS IN INCHES

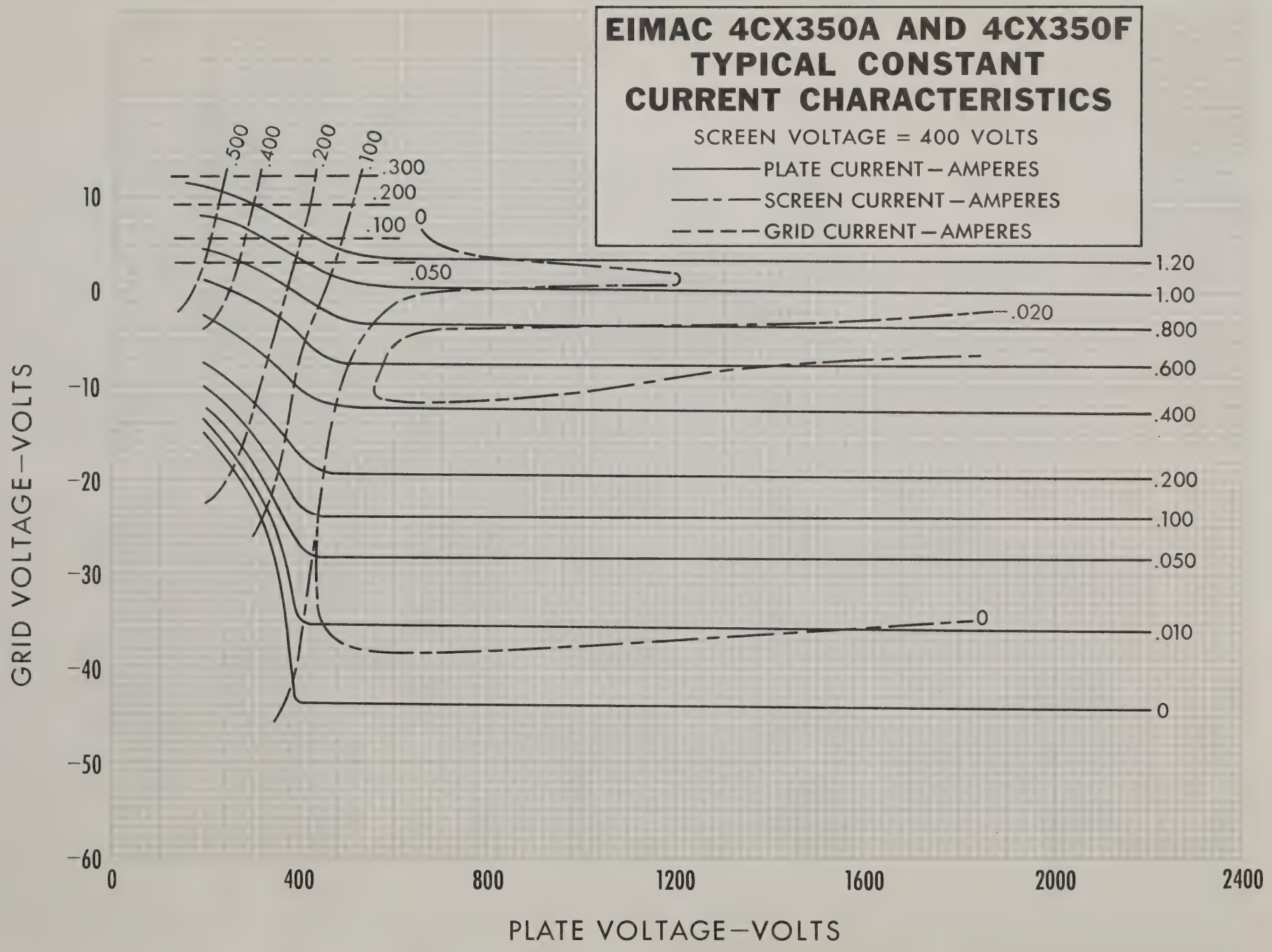
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	2.324	2.464	
B	1.610	1.640	
C	1.810	1.910	
D	.750	.810	
E	.710	.790	
F		1.406	
G	.187		
H	BASE: B8-236 (JEDEC DESIGNATION)		
J	.559	.573	
K	.240	.280	



DIMENSIONS IN INCHES

* CONTACT SURFACE


EIMAC 4CX350A AND 4CX350F
TYPICAL CONSTANT
CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 300 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – VOLTS
20
10
0
−10
−20
−30
−40
−50
0
400
800
1200
1600
2000
2400
.300
.200
.100
.300
.200
.100
.050
0
.010
1.20
1.00
.800
.600
.400
−0.10
.200
.100
.050
.010
0
0

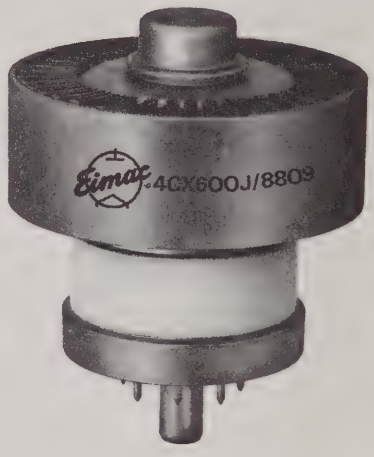

EIMAC 4CX350A AND 4CX350F
TYPICAL CONSTANT
CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 400 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – VOLTS
10
0
−10
−20
−30
−40
−50
−60
0
400
800
1200
1600
2000
2400
.500
.400
.200
.100
.300
.200
.100
0
.050
.020
0
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8809
4CX600J

RADIAL BEAM TETRODE

The EIMAC 8809/4CX600J is a ceramic/metal, forced-air cooled, radial beam tetrode with a rated maximum plate dissipation of 600 watts. It is a low-voltage, high-current tube specifically designed for exceptionally low intermodulation distortion and low grid interception. The low distortion characteristics make the 8809/4CX600J especially suitable for radio-frequency and audio-frequency linear amplifier service.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater: Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	5.4 A
Transconductance (Average):	
I_b = 0.3 Adc, E_{c_2} = 350 volts	27,000 μmhos
Direct Interelectrode Capacitances (grounded cathode) [2]	
Input	50.0 pF
Output	6.3 pF
Feedback	0.13 pF
Frequency of Maximum Rating:	
CW	150 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.71 in; 68.8mm
Diameter	2.08 in; 52.8mm
Net Weight	7.7 oz; 218gm
Operating Position	Any

Effective 5-1-70
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Printed in U.S.A.

Maximum Operating Temperature:

Ceramic/Metal Seals	250 °C
Anode Core	250 °C
Base	JEDEC B8-236
Recommended Air System Socket	EIMAC SK-607
Recommended Air Chimney	EIMAC SK-646

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN
Class AB

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	450 VOLTS
DC PLATE CURRENT	0.6 AMPERE
PLATE DISSIPATION	600 WATTS
SCREEN DISSIPATION	15 WATTS
GRID DISSIPATION	1 WATT

1. Adjust to specified zero-signal dc plate current.
2. Driving power specified includes power dissipated in a 1000 Ω swamping resistor between grid and cathode.
3. The intermodulation distortion products are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage[5]	2000	2500	3000	Vdc
Screen Voltage	350	350	375	Vdc
Grid Voltage[1]	-41	-41	-45	Vdc
Zero-Signal Plate Current	300	175	175	mAdc
Single-Tone Plate Current	500	680	665	mAdc
Two-Tone Plate Current	350	475	453	mAdc
Single-Tone Screen Current[4]	5	30	6	mAdc
Two-Tone Screen Current[4]	-2	10	-2.2	mAdc
Single-Tone Grid Current[4]	0	0.5	0	mAdc
Two-Tone Grid Current[4]	0	0.2	0	mAdc
Peak rf Grid Voltage[4]	32	70	71	v
Peak Driving Power[2]	0.5	2.6	2.7	w
Useful Output Power	550	1100	1235	W
Resonant Load Impedance	2000	2000	2400	Ω
Intermodulation Distortion Products[3]				
3rd Order	-43	-40	-35	db
5th Order	-43	-40	-50	db

4. Approximate values.
5. An unbypassed cathode resistor of 11 ohms is used at plate potentials of 2,500 and 3,000 volts.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB_1, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE	3000 VOLTS
DC SCREEN VOLTAGE	450 VOLTS
DC PLATE CURRENT	0.6 AMPERE
PLATE DISSIPATION	600 WATTS
SCREEN DISSIPATION	15 WATTS
GRID DISSIPATION	1 WATT

1. Approximate value.
2. Adjust to give stated zero-signal plate current.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	2000	2500	3000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1/2]	-52	-52	-52	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max. Signal Plate Current	1.13	1.14	1.14	Adc
Zero-Signal Screen Current[1]	-1	-2	0	mAdc
Max. Signal Screen Current[1]	52	48	52	mAdc
Peak Driving Power	0	0	0	w
Plate Output Power	1430	1720	2165	W
Load Resistance (Plate to Plate)	3850	4200	5320	Ω

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	5.0	5.8	A
Cathode Warmup Time	3	---	minutes
Interelectrode Capacitances [1] (grounded cathode connection)			
Input	46.0	54.0	pF
Output	5.7	7.0	pF
Feedback	---	0.2	pF

1. In shielded fixture.

APPLICATION

COOLING - The maximum temperature rating for the anode core of the 4CX600J is 250°C. Sufficient forced air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 megahertz), for the tube mounted in the recommended air-system socket and chimney, and air flowing in the base-to-anode direction.

	Sea Level		10,000 Feet	
Plate Dissipation watts	Air Flow CFM	Pressure Drop in. water	Air Flow CFM	Pressure Drop in. water
600	19.8	0.76	29.0	1.12

Since the power dissipated by the heater represents about 35 watts and since grid plus screen dissipation can, under some conditions, represent another 16 watts, allowance has been made in preparing this tabulation for an additional 51 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling.

HEATER - The rated heater voltage for the 4CX600J is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

GRID OPERATION - The grid dissipation rating of the 4CX600J is 1 watt. The design features which make the 4CX600J such an extremely linear tube also contribute to very low grid interception. It will be found that the grid will be driven into the positive grid region in the typical operation of the tube. The grid current will usually be less than 1.0 milliampere.

SCREEN OPERATION - Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on the individual tube. The 4CX600J, under some operating conditions, may indicate negative screen currents in the order of 10 milliamperes.

The maximum rated power dissipation for the screen grid in the 4CX600J is 15 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic

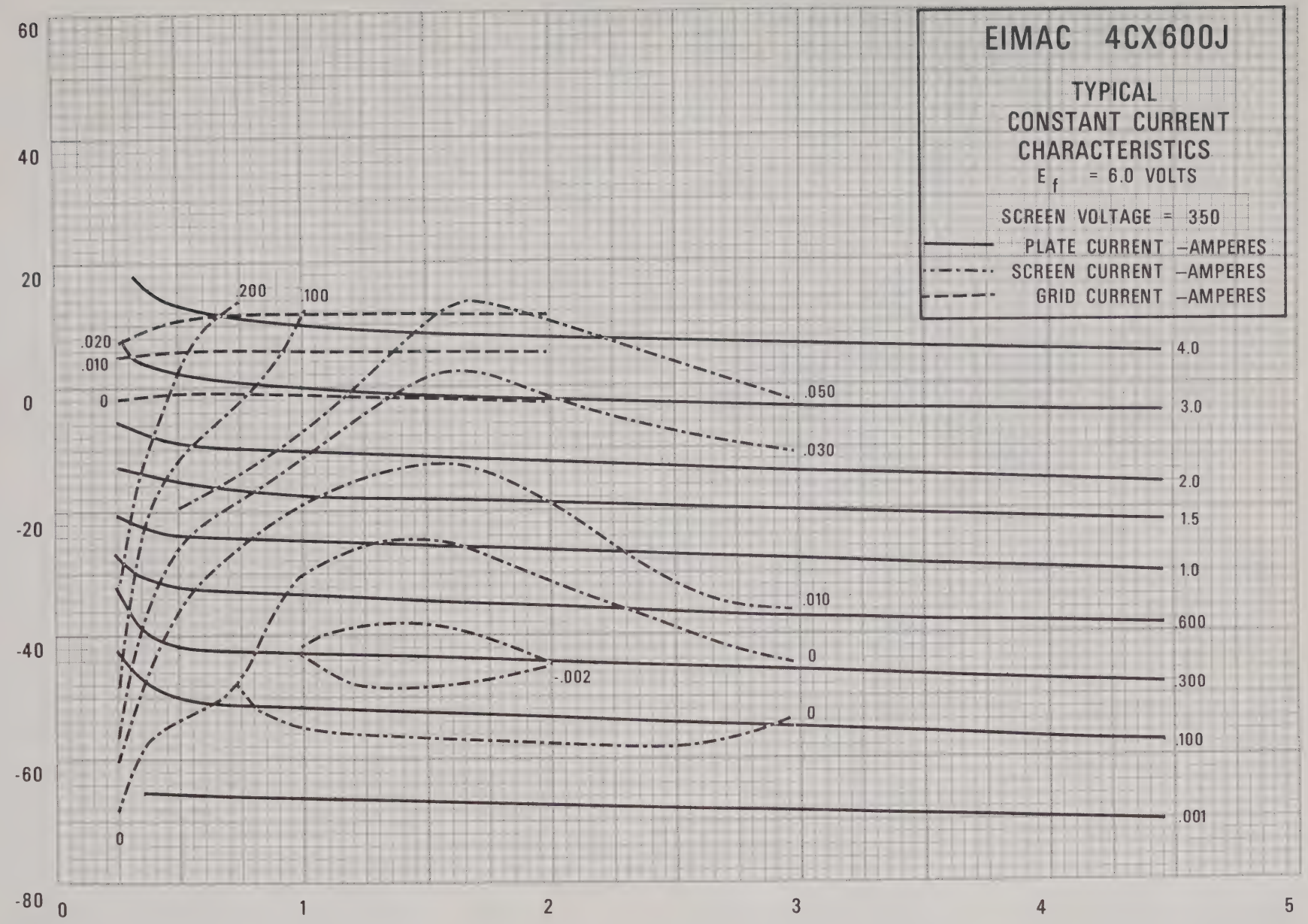
with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 20 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

PLATE OPERATION - The maximum rated plate dissipation power is 600 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

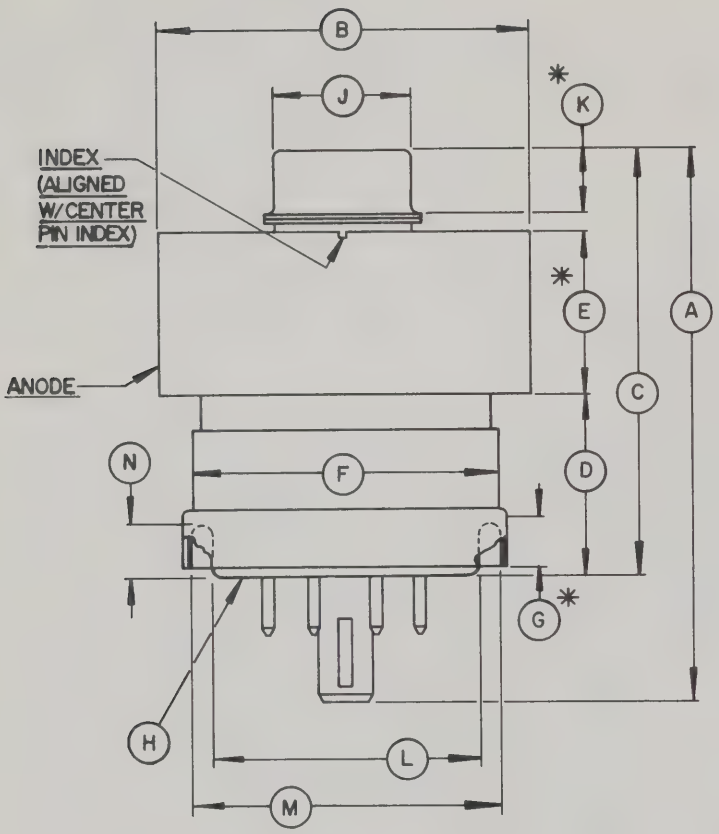
The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency loses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

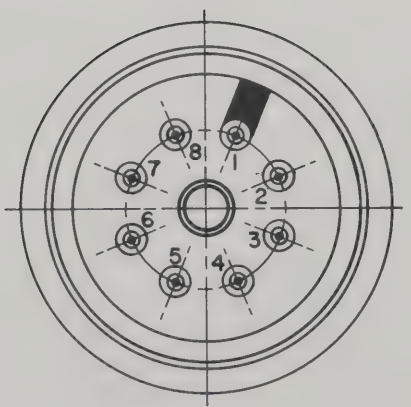
INTERMODULATION DISTORTION - The typical radio frequency linear amplifier operating conditions, including the distortion data, are based on actual operation in a grid-driven amplifier. Because the 4CX600J has very low grid interception it is possible to drive the grid positive without any adverse effects upon the distortion level or upon the driver. Class AB2 linear amplifier operation is therefore possible and recommended. It is also recommended that a low impedance driver be used and that the input of the 4CX600J be swamped with a 1000 ohm resistor from grid to cathode so as to provide an almost constant load to the driver.


EIMAC 4CX600J
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.0 VOLTS
SCREEN VOLTAGE = 350
PLATE CURRENT –AMPERES
SCREEN CURRENT –AMPERES
GRID CURRENT –AMPERES
60
40
20
0
-20
-40
-60
-80
0
1
2
3
4
5
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
.200
.100
.020
.010
0
.050
.030
.010
0
.002
0
0
4.0
3.0
2.0
1.5
1.0
.600
.300
.100
.001

CURVE #3836



DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	2.507	2.707	63.68	68.76
B	2.050	2.080	52.07	52.83
C	1.973	2.173	50.11	55.19
D	0.910	1.030	23.11	26.16
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE: B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55
K	0.240	--	6.10	--
L	1.175	1.190	29.85	30.23
M	1.325	1.360	33.66	34.54
N	0.205	--	5.21	--



PIN DATA

PIN 1 &/OR BASE RING-SCREEN GRID

PINS 2,4,7-CONTROL GRID

PINS 3,6,8-CATHODE

PIN 5-HEATER

CENTER PIN-HEATER

TECHNICAL DATA

8560A

CONDUCTION-COOLED
RADIAL-BEAM
POWER TETRODE

The 8560A is a ceramic/metal conduction-cooled, external-anode radial-beam tetrode intended for use as an rf amplifier or oscillator or in audio amplifier or modulator service.

The 8560A has electrical characteristics which are similar but not identical to the 7203/4CX250B.

Anode dissipation is limited only by heat-sink capability, and the tube is designed for operation at a heater voltage of 6.0 volts.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater: Voltage	6.0 ± 0.3 V
Current, at 6.0 volts	2.6 A
Cathode-Heater Potential, Maximum	±150 V
Amplification Factor (Average):	
Grid-to-screen	5
Direct Interelectrode Capacitances (Grounded Cathode)[2]	
Cin	16.5 pF
Cout	4.6 pF
Cgp	0.04 pF
Frequency of Maximum Rating:	
CW	500 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.445 in; 62.1 mm
Diameter	1.630 in; 41.4 mm
Net Weight	8.2 oz; 235 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals and Anode Core	250°C
Cooling: Conduction Cooled	
Recommended Beryllium Oxide thermal link	EIMAC SK-1920
Recommended Socket	EIMAC SK-660 Series
Base	Special 9-Pin JEDEC B8-236

(Effective 7-15-71) © by Varian

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN (SSB)

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	See COOLING NOTE
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [1]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	250	250	250	mAdc
Two-Tone Plate Current	190	190	190	mAdc
Single-Tone Screen Current [2]	10	8	5	mAdc
Two-Tone Screen Current [2]	2	-1	-2	mAdc
Single-Tone Grid Current [2]	0	0	0	mAdc
Peak rf Grid Voltage [2]	50	50	50	v
Plate Output Power	120	215	300	W
Resonant Load Impedance	2000	3000	4000	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS

Class AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	See COOLING NOTE
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [1]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Carrier Plate Current	150	150	150	mAdc
Carrier Screen Current	-3	-4	-4	mAdc
Peak rf Grid Voltage [2]	25	25	25	v
Plate Output Power	30	50	65	W

1. Adjust to specified zero-signal dc plate current

2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	See COOLING NOTE
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)

	500	1000	1500	2000	500 MHz	
Plate Voltage	500	1000	1500	2000	2000	Vdc
Screen Voltage	250	250	250	250	300	Vdc
Grid Voltage	-90	-90	-90	-90	-90	Vdc
Plate Current	250	250	250	250	250	mAdc
Screen Current [1]	45	38	21	19	10	mAdc
Grid Current [1]	35	31	28	26	25	mAdc
Peak rf Grid Voltage [1]	114	114	112	112	---	v
Measured Driving Power [1]	4.0	3.5	3.2	2.9	---	W
Plate Input Power	125	250	375	500	500	W
Plate Output Power	70	190	280	390	225	W
Heater Voltage	6.0	6.0	6.0	6.0	5.5	V

1. Approximate value.

COOLING NOTE: When using the SK-1920 BeO thermal link between the anode and heat sink, the maximum allowable thermal gradient from the hottest part of the anode to the heat sink is 1.9°C per watt of anode dissipation. Example: Maximum anode temperature = 250°C; maximum heat sink temperature for 200 watts of anode dissipation is then $250°C - \frac{200\,W}{1.9°C/W} = 145°C$

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.20 AMPERE
PLATE DISSIPATION[1]	See COOLING NOTE
SCREEN DISSIPATION[2]	12 WATTS
GRID DISSIPATION[2]	2 WATTS

1. Corresponds to 250 watts at 100% sine-wave modulation.

2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 175 MHz)

Plate Voltage	500	1000	1500	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-100	-100	-100	Vdc
Plate Current	200	200	200	mAdc
Screen Current[3]	31	22	20	mAdc
Grid Current[3]	15	14	14	mAdc
Peak rf Grid Voltage	118	117	117	v
Calculated Driving Power	1.8	1.7	1.7	W
Plate Input Power	100	200	300	W
Plate Output Power	60	145	235	W

3. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB , Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	See COOLING NOTE
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

1. Approximate value.
2. Per Tube.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1,3]	-55	-55	-55	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max Signal Plate Current	500	500	500	mAdc
Max Signal Screen Current[1]	20	16	10	mAdc
Max Signal Grid Current[1]	0	0	0	mAdc
Peak af Grid Voltage[2]	50	50	50	v
Peak Driving Power	0	0	0	w
Plate Input Power	500	750	1000	W
Plate Output Power	240	430	600	W
Load Resistance (plate to plate)	3500	6200	9500	Ω

3. Adjust to give stated zero-signal plate current.

NOTE TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 6.0 volts	2.3	2.9	A
Interelectrode Capacitances (grounded cathode) [1]			
Cin	14.2	17.2	pF
Cout	4.0	5.0	pF
Cgp	---	0.06	pF
Cathode Warmup Time	30	---	sec

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with EIA Standard RS-191. (See APPLICATION NOTE on Capacitance)

APPLICATION

MOUNTING & SOCKETING - The 8560A may be mounted in any position, but its mounting is normally controlled by the heat sink configuration and location. Where possible, the socket can be mounted on a bracket which in turn is mounted to the heat sink so that the one sink will act for removal of heat from the tube anode and also the tube base. The EIMAC SK-1920 beryllium oxide (BeO) thermal link is available for use between the tube anode and the heat sink. BeO is a ceramic material which exhibits high thermal conductance, similar to aluminum, and high electrical resistance and low loss typical of ceramics. Properly installed, it provides a low thermal resistance path allowing the anode heat to be transferred to the heat sink, while providing electrical isolation between the anode and the sink.

The EIMAC SK-660 series of sockets are designed for use in heat-sink applications. The SK-660 and SK-660A both use a high-alumina ceramic body, while the SK-661 and the SK-661A use a BeO body. The SK-661A includes a bracket which is adaptable to some heat-sink design applications.

VIBRATION & SHOCK - The 8560A is capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tube will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration more severe than this are expected, it is suggested that other, more rugged, EIMAC tube types be considered.

COOLING - This tube is designed for use in a conduction-cooled system, where the anode is in direct intimate contact with a heat sink, or coupled to the heat sink by means of a BeO thermal link. The heat sink in turn can be cooled by natural (free) convection, forced-air convection, liquid cooling, or a combination of these methods. The design choice is determined by the tube application, but in all cases the cooling system must maintain the anode and the ceramic/metal seal temperatures below 250°C.

Intimacy of contact and pressure are two factors which will effect transfer of heat from the tube anode to the heat sink, whether direct or through a thermal link such as the EIMAC SK-1920. A good thermally conductive compound should be used in the interface between mating parts to reduce thermal resistance of the joints. Examples of commercially available thermal joint compound are:

WAKEFIELD 120 - Wakefield Engineering Co., Wakefield, Mass. 01880.

DOW CORNING 340 - Dow Corning Corp., Midland, Mich. 48640

ASTRODYNE THERMAL BOND 312 - Astrodyne Inc., Burlington, Mass. 01803.

G.E. INSULGREASE G641 - G.E. Company, Cleveland, Ohio 44117.

The method of fastening the tube to the heat sink should provide reasonable compression to reduce interface thermal resistance. When it is desired to insulate the anode from the heat sink, the EIMAC SK-1920 thermal link is recommended, as it is the correct size and thickness to match the physical and electrical characteristics of the 8560A tube.

Socketing is accomplished with one of the units mentioned earlier, mounted so as to provide a path for heat from the base of the tube to a heat-sink surface. The designer is cautioned to allow for some lateral movement in the socket mount, and to make sure the anode (or anode/thermal link combination) is flat against the heat sink before the socket mounts are tightened, or heat transfer may be seriously affected.

In all cases, temperature of the tube anode and the ceramic/metal seals is the limiting factor, and the equipment designer is encouraged to use temperature-sensitive paint or other temperature-sensing devices in connection with any equipment design before the layout is finalized.

HEATER - The rated heater voltage for the 8560A is 6.0 volts and should be maintained as closely as practical. Short-time changes of ±10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ±5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 MHz, transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend on frequency, plate current, and driving power. When the tube is driven to maximum input as a Class-C amplifier, the heater voltage should be reduced according to the following table:

Frequency (MHz)	Ef (Volts)
300 or lower	6.00
301 to 400	5.75
401 to 500	5.50

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 mA for plate-modulated operation and 250 mA for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving-power requirements for amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approximately 15 mA.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 8560A.

PLATE OPERATION - The maximum rated plate dissipation power is 250 watts. In plate-modulated applications the carrier plate dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

VHF OPERATION - The 8560A is suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

DANGER-BERYLLIUM OXIDE CERAMICS (BeO) Do not alter, grind, lap, fire, chemically clean, or perform any other operation on the SK-1920 Beryllium Oxide thermal link used with the 8560A or any other equivalent section of BeO used with the 8560A. Normal use of Beryllium Oxide ceramics parts is not hazardous, but the user is cautioned that breathing small quantities of the dust or fumes from Beryllium Oxide can seriously injure or kill.

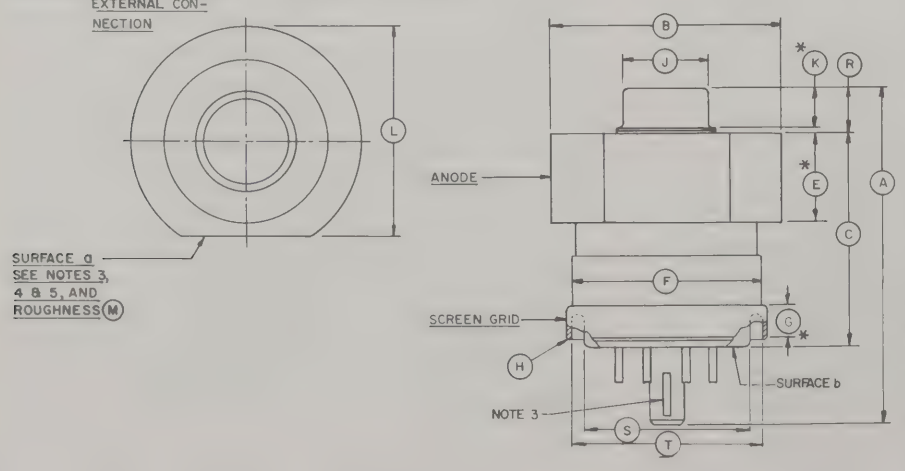
HIGH VOLTAGE - The 8560A operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS-If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Dept., EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

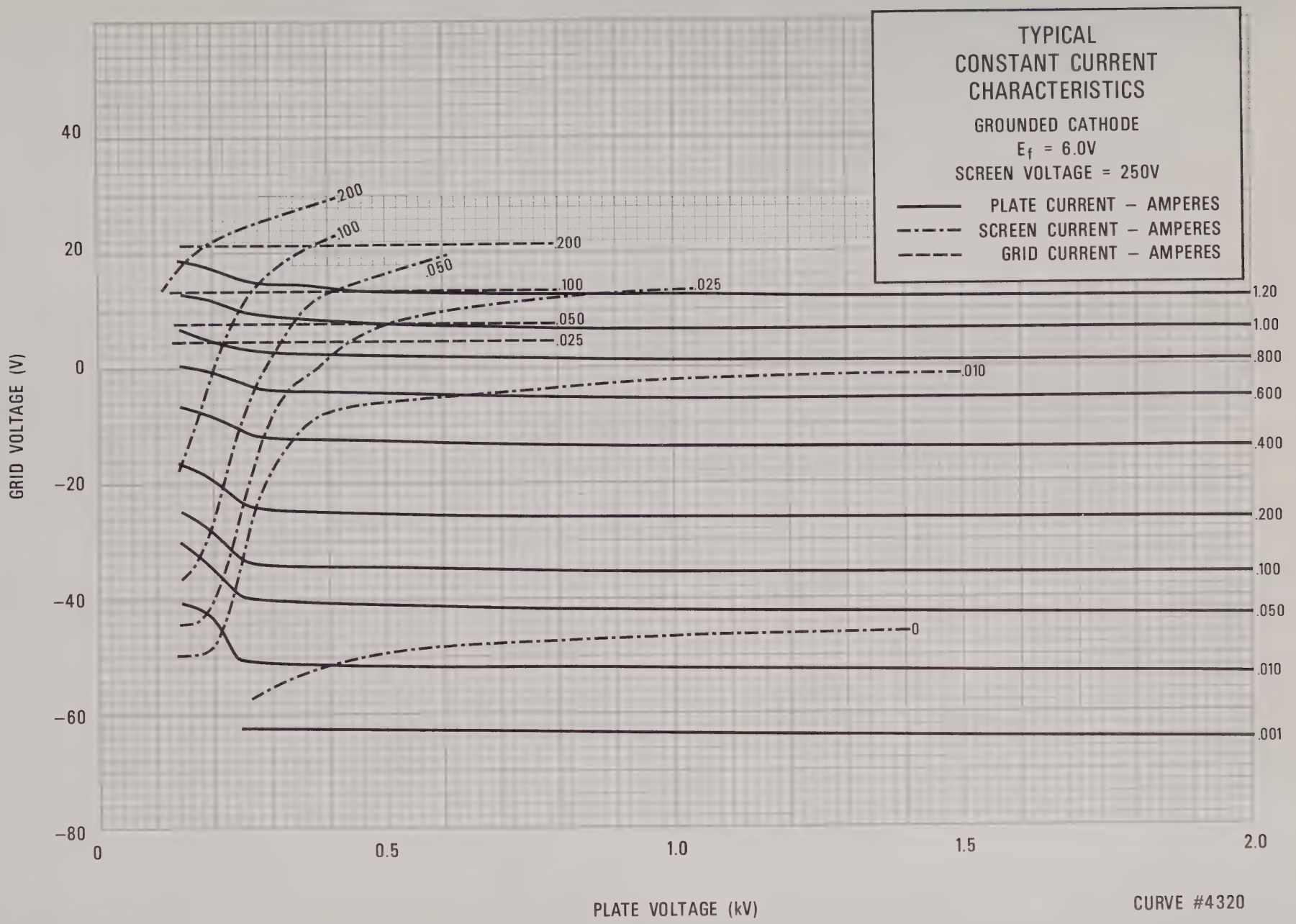
PIN NO. 1 SCREEN GRID
PIN NO. 2 CATHODE
PIN NO. 3 HEATER
PIN NO. 4 CATHODE
PIN NO. 5 I.C. DO NOT USE FOR EXTERNAL CONNECTION
PIN NO. 6 CATHODE
PIN NO. 7 HEATER
PIN NO. 8 CATHODE
CENTER PIN – CONTROL GRID

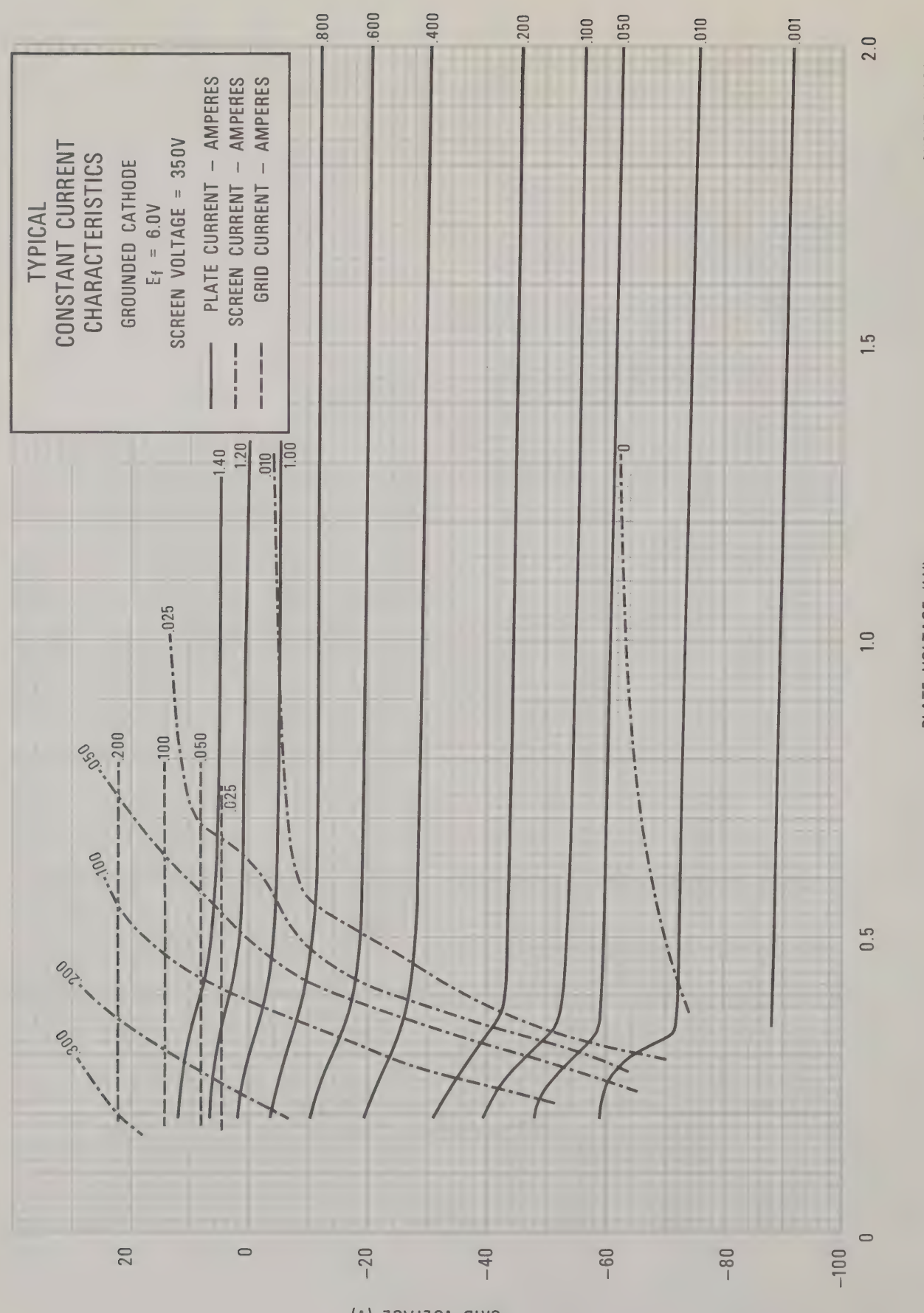


DIMENSIONAL DATA

DIM.	INCHES MIN	INCHES MAX	INCHES REF.	MILLIMETERS MIN.	MILLIMETERS MAX.	MILLIMETERS REF
A	2.305	2.445	- -	58.55	62.10	- -
B	1.620	1.630	- -	41.15	41.40	- -
C	1.530	1.590	- -	38.86	40.39	- -
D	- -	- -	- -	- -	- -	- -
E	0.660	0.740	- -	16.76	18.80	- -
F	- -	1.406	- -	- -	35.71	- -
G	0.187	- -	- -	4.75	- -	- -
H	BASE: B8-236 (JEDEC DESIGNATION)					
J	0.559	0.572	- -	14.20	14.53	- -
K	0.240	- -	- -	6.10	- -	- -
L	1.525	1.540	- -	38.74	39.12	- -
M	- -	32AA	- -	- -	32AA	- -
N	89°	91°	- -	89°	91°	- -
P	88°	92°	- -	88°	92°	- -
R	0.270	0.310	- -	6.86	7.87	- -
S	- -	1.194	- -	- -	30.33	- -
T	1.338	- -	- -	33.98	- -	- -

NOTES:
1. * CONTACT SURFACE.
2. REF. DIMS. ARE FOR INF. ONLY AND ARE NOT REQD. FOR INSP PURPOSES.
3. SUR. a TO BE PERP TO INDEX KEY LATERAL AXIS WITHIN (P) LIMITS AND ON SAME SIDE.
4. SUR a MUST BE FLAT WITHIN .001 & PERP TO SUR. b WITHIN (N) LIMITS.
5. SUR. a TO BE FREE OF ANY CODING & LABELING.


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 6.0V
SCREEN VOLTAGE = 250V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
40
20
0
−20
−40
−60
−80
0
0.5
1.0
1.5
2.0
PLATE VOLTAGE (kV)
CURVE #4320
.200
.100
.050
.025
.010
0
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
.001


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 6.0V
SCREEN VOLTAGE = 350V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
.800
.600
.400
.200
.100
.050
.010
.001
1.40
1.20
.010
1.00
.025
.050
.100
.200
.300
.025
.100
.200
.050
0
GRID VOLTAGE (V)
20
0
-20
-40
-60
-80
-100
0
0.5
1.0
1.5
2.0
PLATE VOLTAGE (kV)

CURVE #4321

TECHNICAL DATA

8904
4CX350FJ

RADIAL BEAM
POWER TETRODE

The EIMAC 8904/4CX350FJ is a compact radial-beam tetrode with a maximum plate dissipation of 350 watts, intended for Class AB linear rf amplifier service. The tube has rugged internal construction features.

The 8904/4CX350FJ may be used as an exact replacement for the 8322/4CX350F in most applications, requiring only minor circuit adjustment and retuning. The tube has improved intermodulation distortion characteristics. It contains a 26.5 volt heater, and is recommended for new equipment designs.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-coated, Unipotential

Voltage	26.5 ± 1.3 V
Current, at 26.5 volts	0.65 A

Transconductance (Average):

I_b = 150 mAdc	22,000 μmhos

Amplification Factor (Average):

Grid to Screen	17

Direct Interelectrode Capacitances (grounded cathode)[2]

Cin	22.0 pF
Cout	5.9 pF
Cgp	0.033 pF

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Base	Special 9-pin, JEDEC B8-236
Recommended Air-System Socket	EIMAC SK-600 Series
Recommended Air Chimney	EIMAC SK-600 Series
Maximum Overall Dimensions:	
Length	2.46 in; 62.59 mm
Diameter	1.64 in; 41.65 mm
Operating Position	Any
Cooling	Forced Air

(Effective 9-1-71) © by Varian

Printed in U.S.A.

Net Weight (Approximate)	4 oz; 113 gm
Shipping Weight (Approximate)	1.6 lb; 3.5 kg
Maximum Operating Temperature:	
Anode Core and metal/ceramic seals	250°C

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN
Class AB 1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2500 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	300 MA
PLATE DISSIPATION	350 WATTS
SCREEN DISSIPATION	8 WATTS
GRID CURRENT	2 MA

1. Adjust to specified Zero-Signal Plate Current.
2. Approximate value.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1400	2200	Vdc
Screen Voltage	300	400	Vdc
Grid Voltage [1]	-14	-19	Vdc
Zero-Signal Plate Current	80	100	mAdc
Single-Tone Plate Current	165	227	mAdc
Single-Tone Screen Current [2]	6	8	mAdc
Useful Output Power [3]	100	250	W
Resonant Load Impedance	3600	5000	Ω
Intermodulation Distortion [4]			
3rd Order Products	-45	-40	dB
5th Order Products	-50	-45	db

3. Power delivered to the load.
4. The IMD products are referenced against one tone of a two-equal-tone signal.

NOTE: TYPICAL OPERATION data is obtained from direct measurement. Adjustment of the rf grid voltage to obtain the specified bias, screen, and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in screen current, which is incidental and which will vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct screen grid voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 26.5 volts	0.50	0.81	A
Interelectrode Capacitances[1] (grounded cathode):			
Cin	20.0	24.0	pF
Cout	5.6	6.2	pF
Cgp	---	0.038	pF

APPLICATION

MECHANICAL

MOUNTING - The 4CX350FJ may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen bypass capacitors and may be obtained with either grounded or ungrounded cathode terminals. Air chimneys are also available for these sockets, including a unit which securely clamps the tube into place in the socket for applications where environmental stress is anticipated.

COOLING - Sufficient cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum value. Air requirements to maintain seal temperatures at 225°C in 50°C ambient air are shown. These values apply when the EIMAC

SK-600 or SK-610 socket is used with the SK-606 chimney, with air flowing in the base-to-anode direction.

Minimum Cooling Air Flow Requirements				
Plate Dissipation (watts)	Sea Level		10,000 Feet	
	Air Flow (cfm)	Approx. Press.drop, In. H_2O	Air Flow (cfm)	Approx. Press.drop, In. H_2O
250	5.3	0.6	7.7	0.85
300	6.5	0.9	9.5	1.25
350	7.8	1.2	12.0	1.90

Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt, which may interfere with effective cooling.

The blower selected in any given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown, plus any drop encountered in ducts and filters, and the blower must be designed to deliver the air at the desired altitude.

It should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. One method of measuring the surface temperature is by the use of a temperature-sensitive lacquer or paint. When these materials are used, thin applications must be used to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

SHOCK AND VIBRATION - The 4CX350FJ is recommended for applications where environmental stress is anticipated and reliable operation must be maintained under these circumstances. The tube is routinely tested at a vibration level of 10 G, over the frequency range of 28 to 750 Hertz, with full operating voltages applied, and also tested under 90 G long-duration (11 milliseconds) shock conditions, also with voltages applied. When shock or vibration stressing is expected, it is extremely important that relative motion between socket and tube be prevented or restricted by clamping the tube into place. This may be done with EIMAC Air-System Socket SK-620 or SK-630 and the EIMAC SK-636B chimney, which includes a clamping mechanism.

ELECTRICAL

HEATER - The heater voltage for the 4CX350FJ is 26.5 volts and should be maintained as closely as possible. Short-time variations of ±10% of the rated value will not damage the tube, but voltage should be maintained within ±5% of rated value to minimize variations in performance and to obtain maximum life.

CATHODE OPERATION - The cathode is internally connected to the four even-numbered base pins, and all four corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep cathode leads short and direct and to use conductors with large areas to minimize inductive reactance in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 60 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts, regardless of polarity.

STANDBY OPERATION - When equipment is designed for very low-duty operation, where standby periods of many hours or even days at one time are anticipated, it is good engineering practice to include circuitry for reduction of the heater voltage of an oxide-cathode tube during the standby periods. This will greatly minimize the release of sublimation products within the tube. A reduction in heater voltage of 10% from the nominal value is recommended during such long standby periods, with simultaneous switching to normal voltage when the equipment is switched from STANDBY to OPERATE. A reduction in heater voltage of more than 10% is possible if operation is not attempted for several seconds after switching from the STANDBY to the OPERATE mode.

CONTROL-GRID OPERATION - The grid dissipation rating of the 4CX350FJ is zero watts. The grid current rating of 2.0 milliamperes allows the flow of positive grid current for peak-signal monitoring purposes.

SCREEN-GRID OPERATION - The maximum rated power dissipation for the screen grid of the

4CX350FJ is 8.0 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

If tuning of a linear amplifier circuit is to be done under single-tone conditions, extra care should be exercised to be sure the screen dissipation rating is not exceeded, as this is often the limiting factor during this type of operation.

Protection for the screen can be provided by an over-current relay and by interlocking the screen supply so the plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliameter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind, so that the correct operating voltage will be maintained on the screen under all conditions. A current path from the screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. A series regulator circuit can be used only when an adequate bleeder resistor is provided.

PLATE OPERATION - The maximum rated plate-dissipation power for the 4CX350FJ is 350 watts. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

At frequencies up to approximately 30 Megahertz the top cap on the anode cooler may be used for a plate terminal. At higher frequencies a circular clamp or spring-finger collet encircling the outer surface of the anode cooler should be used.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize inputs. Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event one tube should fail.

UHF OPERATION - The 4CX350FJ is useful in the UHF region. Operation at these frequencies should be conducted with heavy plate loading and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - The 4CX350FJ operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high-

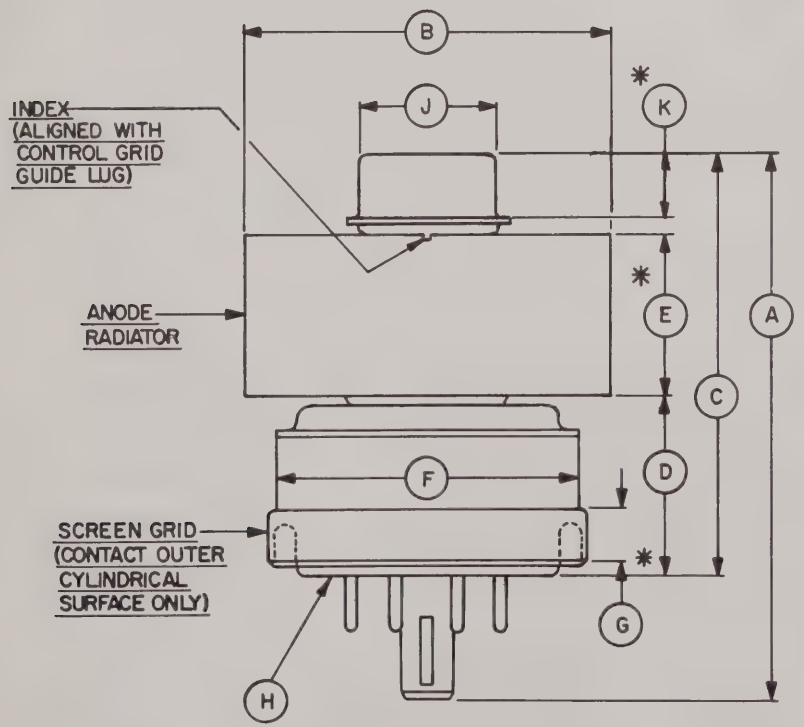
voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

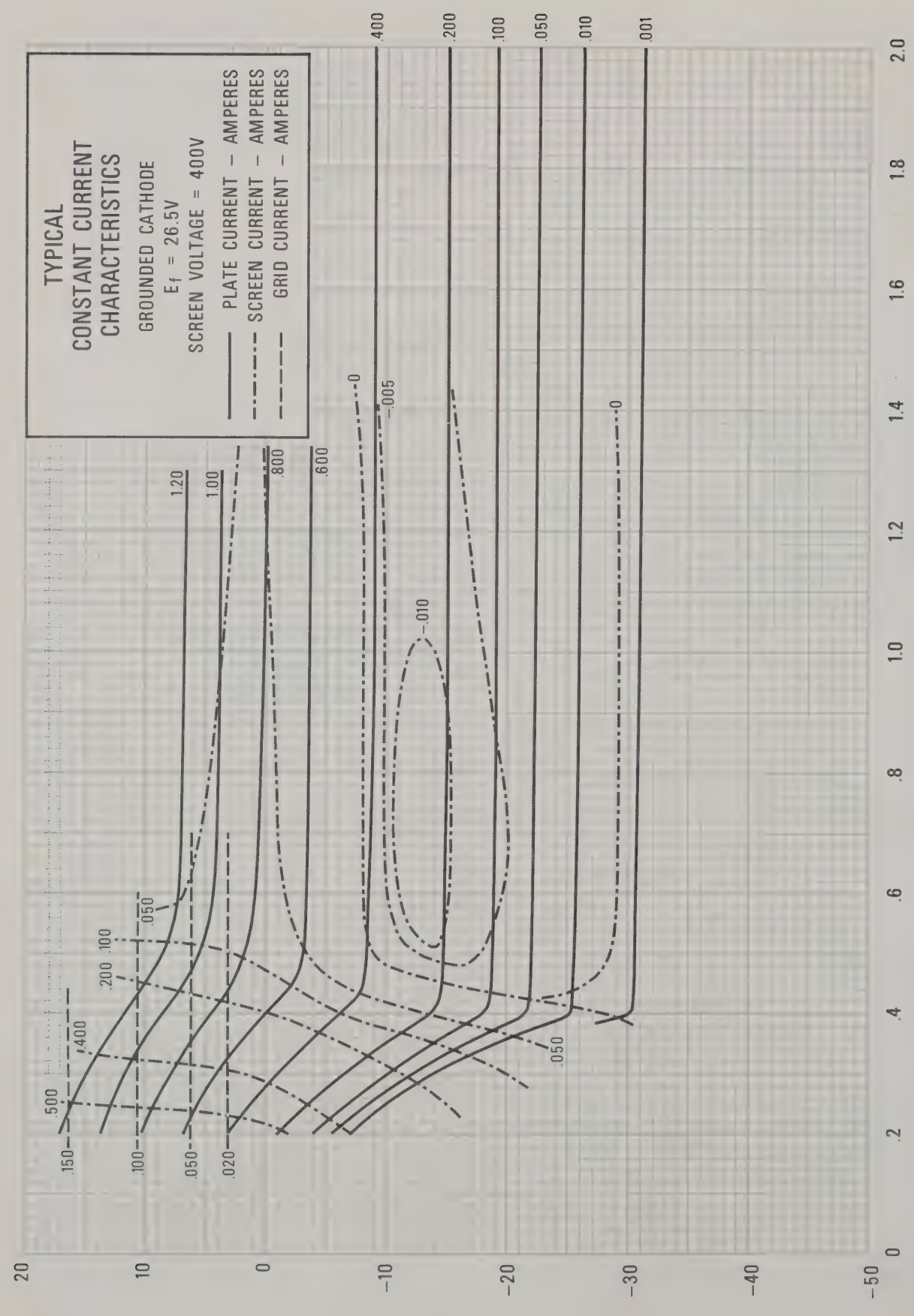
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

PIN No. 1: SCREEN GRID
PIN No. 2: CATHODE
PIN No. 3: HEATER
PIN No. 4: CATHODE
PIN No. 5: I.C. DO NOT USE FOR EXTERNAL CONNECTION
PIN No. 6: CATHODE
PIN No. 7: HEATER
PIN No. 8: CATHODE
CENTER PIN: CONTROL GRID

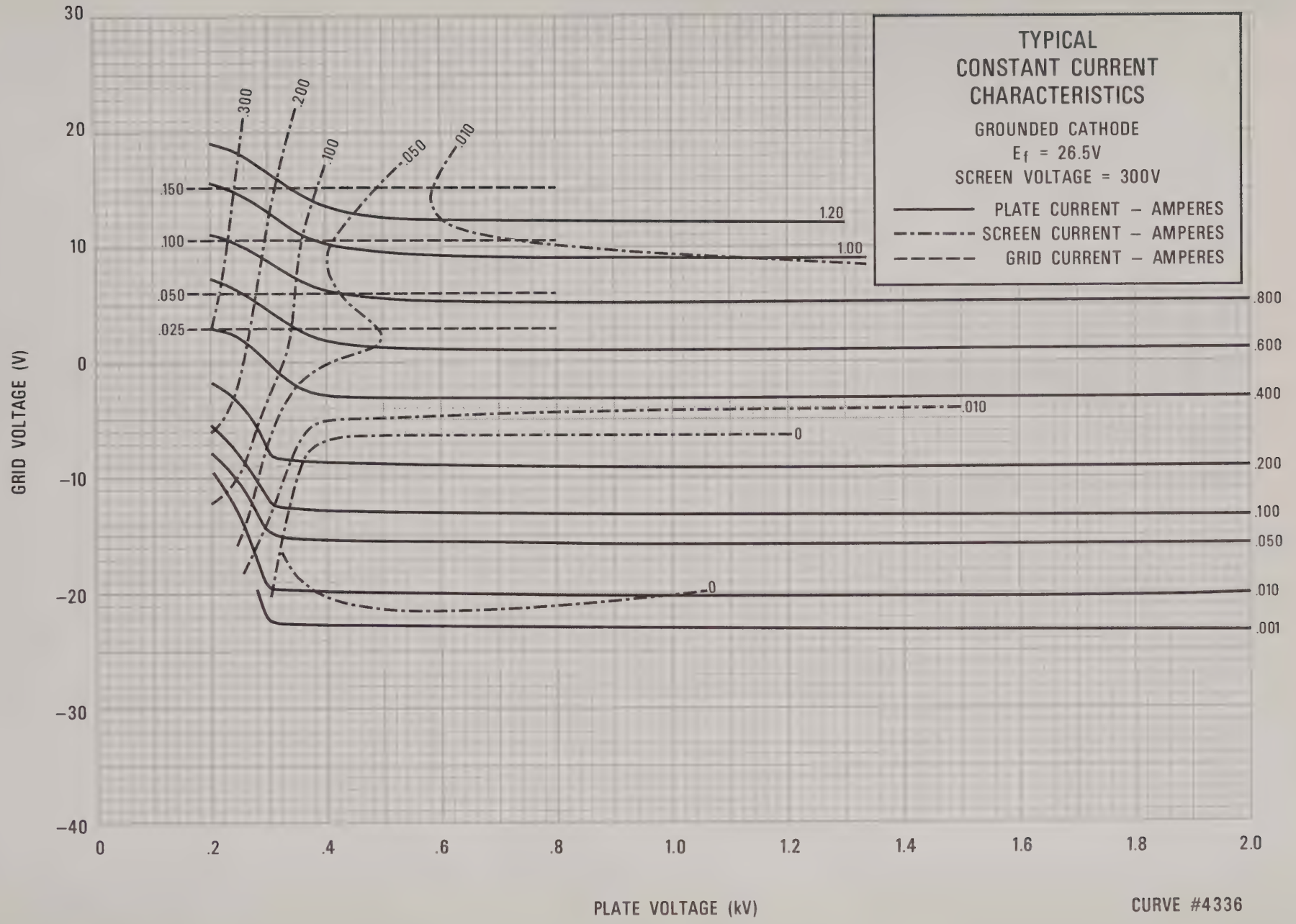
DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	2.324	2.464	59.03	62.59
B	1.610	1.640	40.89	41.66
C	1.810	1.910	45.97	48.51
D	0.750	0.810	19.05	20.57
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE: B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55
K	0.240	--	6.10	--

NOTES:
1. REF. DIMS. ARE FOR INFO. ONLY AND ARE NOT REQD. FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE




TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 26.5V
SCREEN VOLTAGE = 400V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
20
10
0
−10
−20
−30
−40
−50
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
.400
.200
.100
.050
.010
.001
1.20
1.00
.800
.600
.500
.400
.200
.100
.050
.020
.150
.100
.050
.050
.010
.005
0
0

CURVE #4335


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 26.5V
SCREEN VOLTAGE = 300V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #4336
30
20
10
0
−10
−20
−30
−40
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
.300
.200
.100
.050
.010
.150
.100
.050
.025
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
.001
.010
0
0

TECHNICAL DATA

8809 / 4CX600J
8921 / 4CX600JA
ULTRA LINEAR POWER TETRODE

The EIMAC 8809/4CX600J is a ceramic/metal, forced-air cooled, radial beam tetrode with a rated maximum plate dissipation of 600 watts. It is a low-voltage, high-current tube specifically designed for exceptionally low intermodulation distortion and low grid interception. The low distortion characteristics make the 8809/4CX600J especially suitable for radio-frequency and audio-frequency linear amplifier service.



The 8921/4CX600JA has a larger anode cooler for reduced cooling air pressure-drop. It is electrically identical to the 4CX600J.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater: Voltage	6.0 ± .3 V
Current, at 6.0 volts	5.4 A
Cathode-Heater Potential (maximum)	±150 V
Transconductance (Average):	
I_b = 0.3 Adc, E_{c2} = 350 Vdc	27,000 μmhos
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	50.0 pF
Cout	6.3 pF
Cgp	.13 pF

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:

	4CX600J	4CX600JA
Length	2.71 in; 68.8 mm	2.71 in; 68.8 mm
Diameter	2.08 in; 52.8 mm	2.52 in; 64.0 mm
Net Weight	7.7 oz; 218 gm	9.0 oz; 255 gm
Operating Position	Any	
Maximum Operating Temperature:		
Ceramic/Metal Seals	250°C	
Anode Core	250°C	

(Effective 8-15-71) © by Varian Printed in U.S.A.

Cooling	Forced air
Base	JEDEC B8-236
Recommended Air System Socket	SK-607
Recommended Air Chimney (4CX600J)	SK-646
Recommended Air Chimney (4CX600JA)	SK-656

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN Class AB

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	450	VOLTS
DC PLATE CURRENT	0.6	AMPERE
PLATE DISSIPATION	600	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	1	WATT

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB, Grid Driven, Peak Envelope or Modulation Crest Conditions.

Plate Voltage	2000	2000	2500	Vdc
See Notes	---	(4)	(5&6)	
Screen Voltage	350	350	350	Vdc
Grid Voltage 1	-41	-41	-41	Vdc
Zero-Signal Plate Current	300	200	175	mAdc
Single-Tone Plate Current	500	497	680	mAdc
Two-Tone Plate Current	350	365	475	mAdc
Single-Tone Screen Current 3	5	16	30	mAdc
Two-Tone Screen Current 3	-2	3	10	mAdc
Single-Tone Grid Current 3	0	0	0.5	mAdc
Two-Tone Grid Current 3	0	0	0.2	mAdc
Peak rf Grid to Ground Voltage 3.	32	39.5	70	v
Single-Tone Useful Output Power	550	553	1100	W
Resonant Load Impedance	2000	2000	2000	Ω
Intermodulation Distortion Products 2				
3rd Order	-43	-46	-40	db
5th Order	-43	-51	-40	db

1. Adjust to specified zero-signal dc plate current.
2. The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum outout power and are referenced against one tone of a two equal tone signal.
3. Approximate values.
4. Cathode resistor 11 ohms, bypassed by 4000 pF.
5. Cathode resistor 11 ohms, no bypass capacitor.
6. Complex signal such that dc plate current maximum rating of 600 mA not exceeded.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	3000	VOLTS
DC SCREEN VOLTAGE	450	VOLTS
DC PLATE CURRENT	.6	AMPERE
PLATE DISSIPATION	600	WATTS
SCREEN DISSIPATION	15	WATTS
GRID DISSIPATION	1	WATT

TYPICAL OPERATION (Two Tubes) Class AB1

Plate Voltage	2000	2500	2800	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage 1/3	-52	-52	-52	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max. Signal Plate Current	1.13	1.14	1.14	Adc
Zero-Signal Screen Current	-1	-2	0	mAdc
Max. Signal Screen Current	52	48	52	mAdc
Peak af Grid Voltage 2	46	46	46	v
Plate Output Power	1430	1720	1985	W
Load Resistance(plate to plate)	3850	4200	4800	Ω

1. Approximate value.
2. Per Tube.
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	5.0	5.8	A
Cathode Warmup Time	5	--	minutes

Interelectrode Capacitances[1] (grounded cathode connection)	Min.	Max.
Cin	46.0	54.0 pF
Cout	5.7	7.0 pF
Cgp	---	.2 pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

COOLING - The maximum temperature rating for the anode core of the 4CX600J is 250°C. Sufficient forced air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air flow requirements to maintain seal temperature at 225°C in ambient air are tabulated below (for operation below 30 megahertz), for the tube mounted in the recommended air-system socket and chimney, and air flowing in the base-to-anode direction.

Since the power dissipated by the heater represents about 33 watts and since grid plus screen dissipation can represent additional power, allowance has been made in preparing this tabulation for an additional 40 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown below plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling.

Plate Dissipation Watts	4CX600J			
	Sea Level		10,000 FEET	
	Air Flow CFM	Press.Drop in. water	Air Flow CFM	Press.Drop in. water
300	7.0	.3	10.2	.45
450	12.2	.53	17.7	.78
600	26.5	.81	38.7	1.18
	4CX600JA			
300	7.0	.08	10.2	.11
450	12.2	.13	17.7	.19
600	26.5	.21	38.7	.30

HEATER - The rated heater voltage for these tubes is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above the rated value except for short periods.

It is recommended that the heater voltage be applied for a period of not less than 5 minutes before other operating voltages are applied.

Refer to the EIMAC Division of Varian for special instructions if it is necessary to reduce cathode warmup time.

GRID OPERATION - The grid dissipation rating of these tubes is 1 watt. The design features which make these such extremely linear tubes also contribute to very low grid interception. The grid may be driven into the positive grid region in the typical operation of the tube.

SCREEN OPERATION - Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on the individual tube. The 4CX600J and 4CX600JA, under some operating conditions, may indicate negative screen currents in the order of 10 milliamperes.

The maximum rated power dissipation for the screen grid is 15 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a zener regulator may be connected from

screen to cathode; or an electron-tube regulator circuit may be used in the screen supply. It is absolutely essential to use a bleeder if a series regulator is employed. The screen bleeder current should approximate 20 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

PLATE OPERATION - The maximum rated plate dissipation power is 600 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

The top cap on the anode cooler may be used as a plate terminal at low frequencies or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used at high frequencies.

Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency loses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

INTERMODULATION DISTORTION - The typical radio frequency linear amplifier operating conditions, including the distortion data, are based on actual operation in a grid-driven amplified. Because the 4CX600J and 4CX600JA have very low grid interception it is possible to drive the grid positive with minimum adverse effects upon the distortion level or upon the driver. Class AB2 linear amplifier operation is therefore possible and recommended. It is also recommended that a low impedance driver be used and that the input of the 4CX600J or 4CX600JA be swamped with a 1000 ohm resistor from grid to cathode so as to provide an almost constant load to the driver.

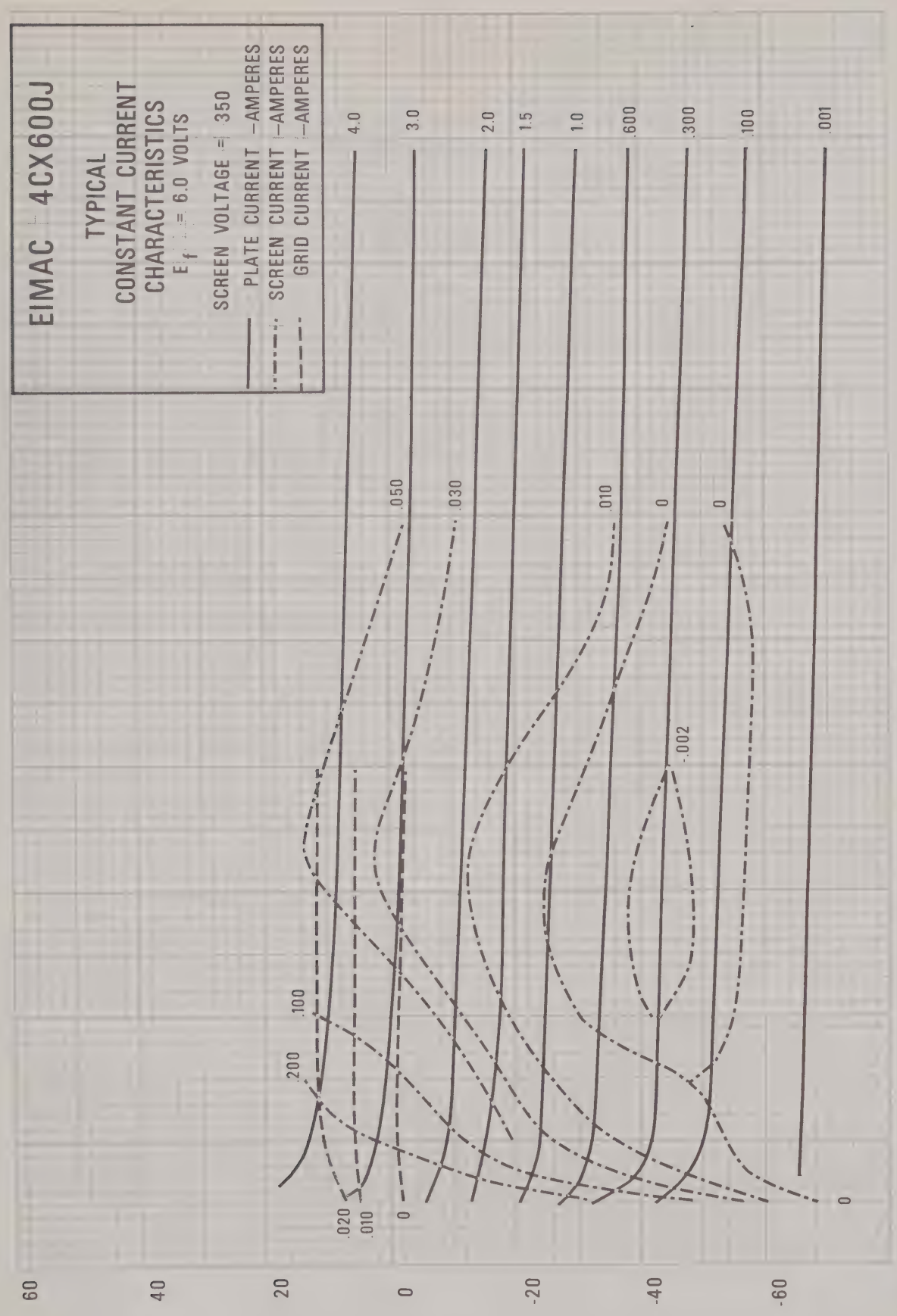
In general, linearity is improved as grid bias value is shifted toward Class A operation. Linearity may also be improved without sacrifice of efficiency by use of cathode resistors bypassed for rf, or with no bypass capacitor. See "Radio Frequency Linear Amplifier, Typical Operation".

CAUTION-HIGH VOLTAGE - Operating voltage for the 4CX600J and 4CX600JA can be deadly, so the equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high voltage circuits and terminals, with interlock switches to open the primary circuits of the power supply and to discharge high voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

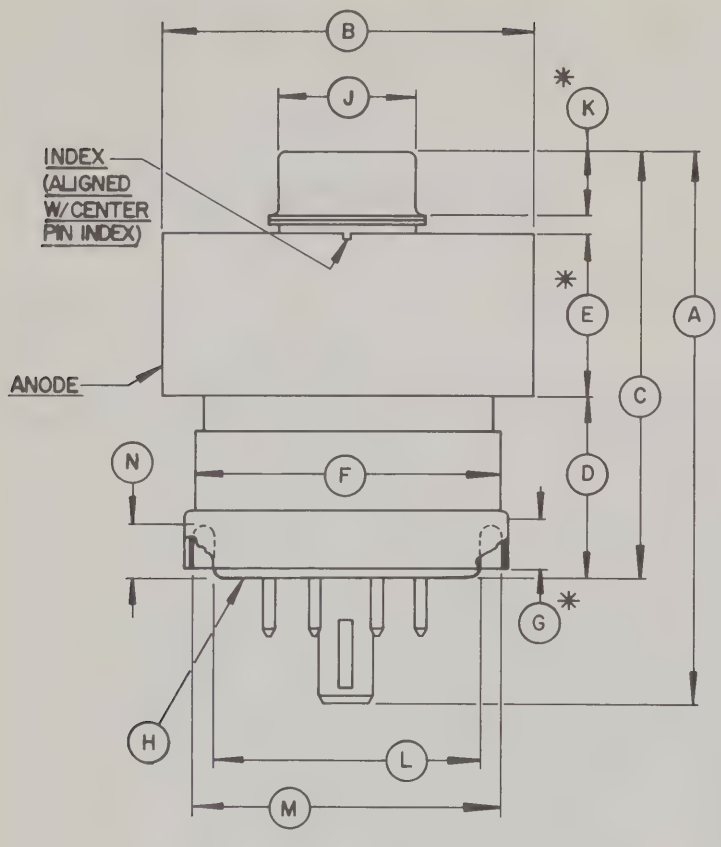
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

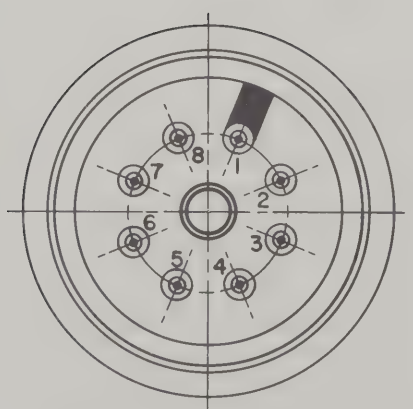
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


EIMAC 4CX600J
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.0 VOLTS
SCREEN VOLTAGE = 350
PLATE CURRENT —AMPERES
SCREEN CURRENT —AMPERES
GRID CURRENT —AMPERES
4.0
3.0
2.0
1.5
1.0
.600
.300
.100
.001
.050
.030
.010
0
.002
0
0
.200
.100
.020
.010
0
60
40
20
0
-20
-40
-60
-80
0
1
2
3
4
5
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)

CURVE #3836



8809/4CX600J DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	2.507	2.707	63.68	68.76
B	2.050	2.080	52.07	52.83
C	1.973	2.173	50.11	55.19
D	0.910	1.030	23.11	26.16
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE: B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55
K	0.240	--	6.10	--
L	1.175	1.190	29.85	30.23
M	1.325	1.360	33.66	34.54
N	0.205	--	5.21	--
8921/4CX600JA				
B	2.485	2.515	63.00	63.80
ALL ELSE SAME AS ABOVE				



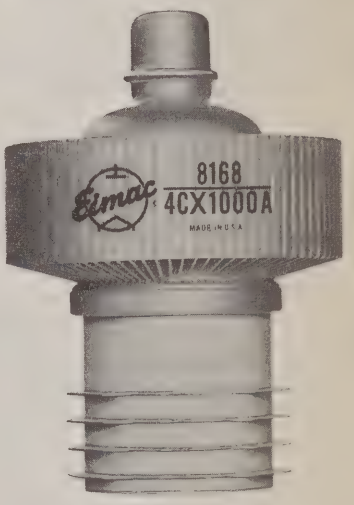
PIN DATA
PIN 1 &/OR BASE RING-SCREEN GRID
PINS 2,4,7-CONTROL GRID
PINS 3,6,8-CATHODE
PIN 5-HEATER
CENTER PIN-HEATER

EITEL-McCULLOUGH, INC.

TENTATIVE DATA

8168
4CX1000A

CERAMIC POWER TETRODE



The Eimac 8168/4CX1000A is a ceramic and metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 r-f linear-amplifier or audio-amplifier applications where its high gain and low distortion characteristics may be used to advantage. At its rated maximum plate voltage of 3000 volts, it is capable of producing 1680 watts of peak-envelope output power. Two 8168/4CX1000As operating in Class-AB_1 will produce 3360 watts of audio power.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	9.5		11.5	amperes
Transconductance (I_b=1.0 ampere)		37,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	uuf
Output	11		13	uuf
Feedback			0.02	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:*	Min.	Nom.	Max.	
Input		35		uuf
Output	11		13	uuf
Feedback			0.005	uuf
Frequency for Maximum Ratings			30	mc

*In shielded fixture.

MECHANICAL

Base			Special, breechblock terminal surfaces	
Maximum Operating Temperatures:				
Ceramic-to-Metal Seals			200°	C
Anode Core			250°	C
Recommended Socket			Eimac SK-800 Series	
Operating Position			Any	
Maximum Over-All Dimensions:				
Height			4.75	inches
Diameter			3.36	inches
Net Weight			27	ounces
Shipping Weight (Approximate)			3	pounds

CLASS-AB_1 RADIO-FREQUENCY LINEAR AMPLIFIER

(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	325	325	325	volts
D-C Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal D-C Plate Current	250	250	250	ma
Single-Tone D-C Plate Current	1.0	1.0	0.9	amp
Two-Tone Average D-C Plate Current	700	700	640	ma
Zero-Signal D-C Screen Current*	—2	—2	—2	ma
Single-Tone D-C Screen Current*	35	35	35	ma
Two-Tone Average D-C Screen Current*	11	10	9	ma
Plate Output Power	1020	1450	1680	watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

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Supersedes sheet dated 8-15-57

CLASS-AB$_1$ AUDIO AMPLIFIER OR MODULATOR

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	325	325	325	volts
D-C Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal D-C Plate Current	500	500	500	ma
Max.-Signal D-C Plate Current	2.0	2.0	1.8	amps
Zero-Signal D-C Screen Current*	—4	—4	—4	ma
Max-Signal D-C Screen Current*	70	70	70	ma
Effective Load, Plate to Plate	1650	2400	3450	ohms
Driving Power	0	0	0	watts
Max-Signal Plate Output Power	2040	2900	3360	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

MECHANICAL

Cooling—Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	200°C
Anode Core	250°C

A flow rate of 28 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 28 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.25 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes increased air flow will be required. For example, at an altitude of 10,000 feet, a flow rate of 40 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.35 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude.*

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

ELECTRICAL

Heater—The rated heater voltage for the 4CX1000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control-Grid Operation—The grid dissipation rating of the 4CX1000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than one milliampere as read on a one-milliampere meter may be permitted to flow for peak-signal monitoring purposes.

Screen-Grid Operation—Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1000A is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated d-c screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the d-c screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the "Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the

screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

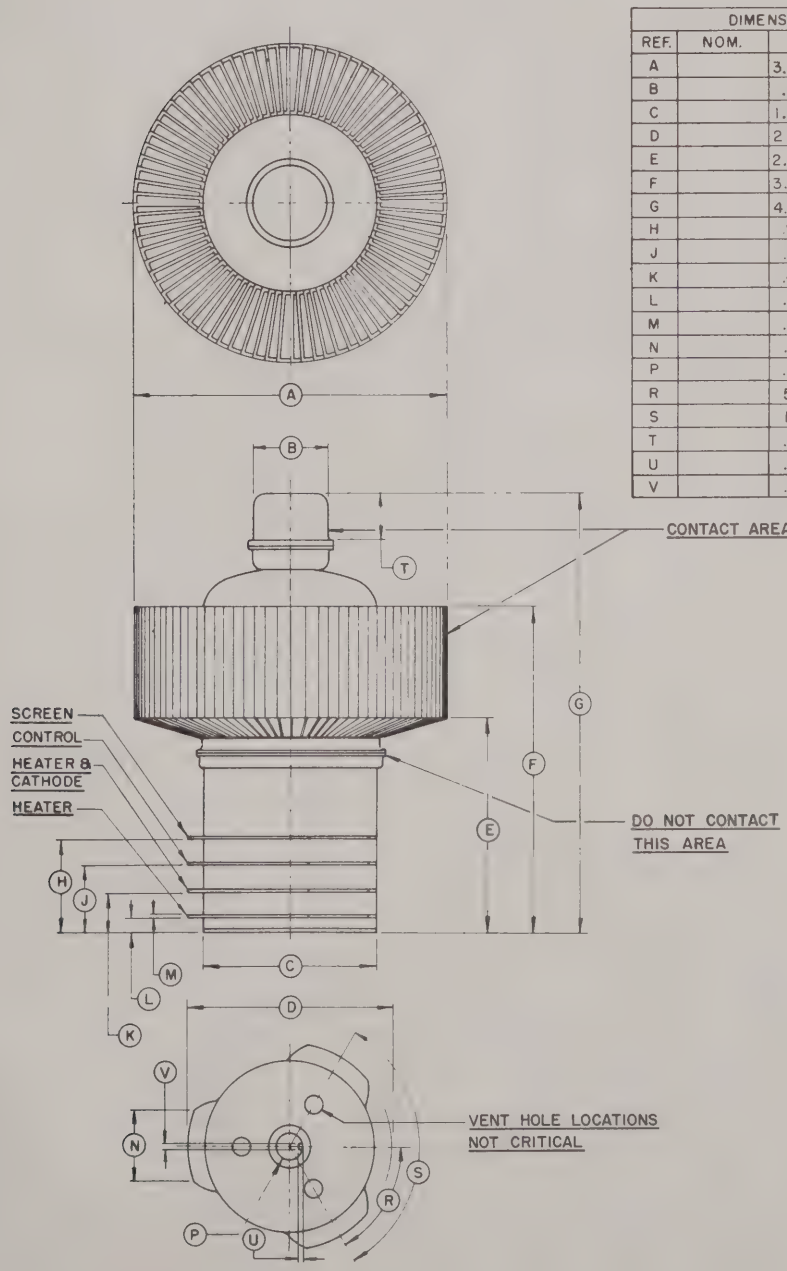
Plate Operation—The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

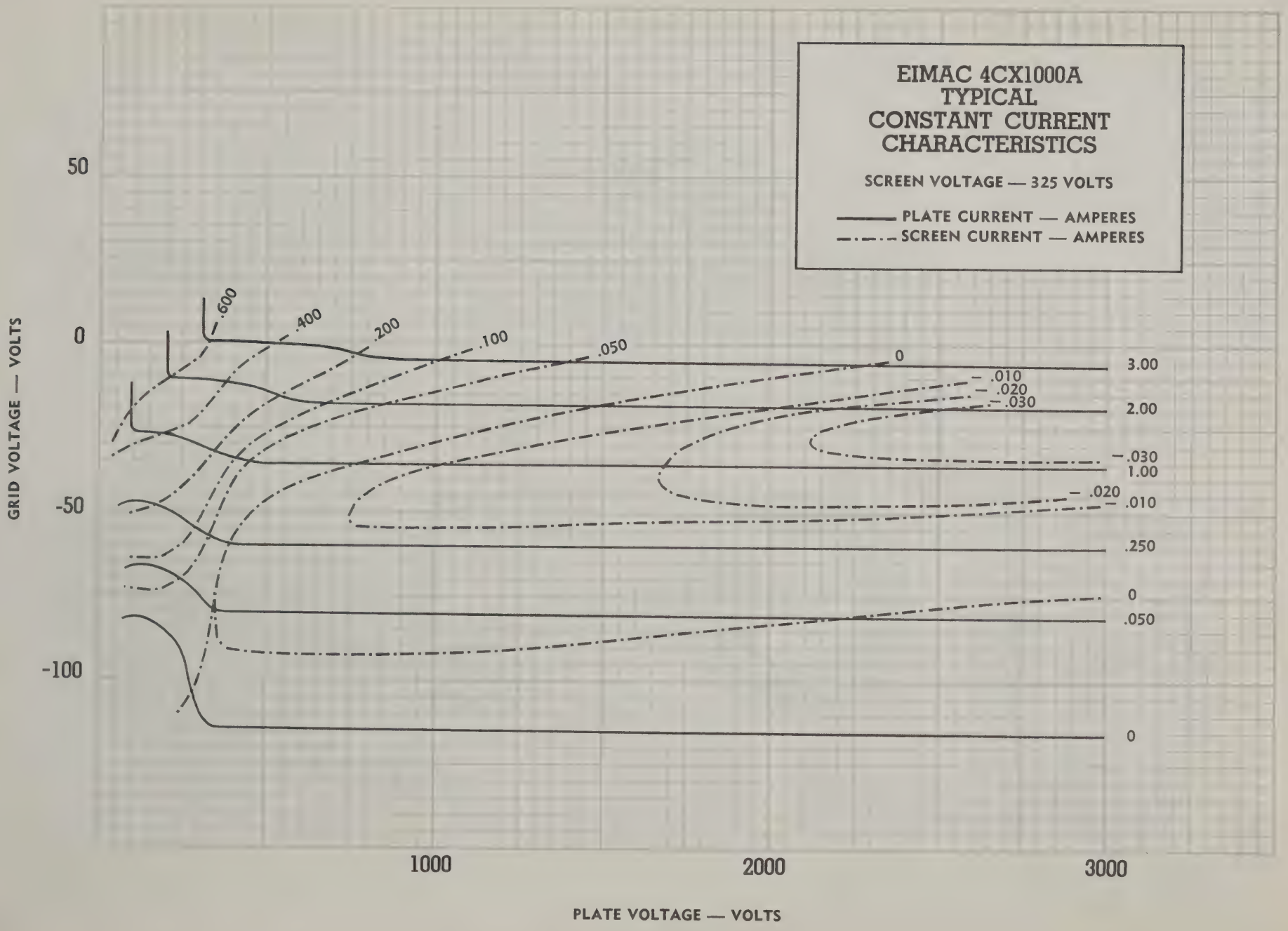
The top cap on the anode cooler may be used as a plate terminal or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used.

Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency losses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Special Applications—If it is desired to operate this tube under conditions different from those given here, write to the Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		3.335	3.365
B		.807	.817
C		1.870	1.900
D		2.250 DIA.	2.300 DIA.
E		2.195	2.380
F		3.410	3.550
G		4.600	4.800
H		.950	1.000
J		.675	.725
K		.400	.450
L		.140	.170
M		.020	.030
N		.700	.800
P		.314 DIA.	.326 DIA.
R		55°	65°
S		115°	125°
T		.470	.530
U		.023	.043
V		.057 DIA.	.073 DIA.




EIMAC 4CX1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 325 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID VOLTAGE — VOLTS
50
0
-50
-100
1000
2000
3000
PLATE VOLTAGE — VOLTS
.600
.400
.200
.100
.050
0
.010
.020
.030
3.00
2.00
.030
1.00
.020
.010
.250
0
.050
0

Eimac

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

8169
4CX3000A

RADIAL-BEAM POWER TETRODE

The Eimac 8169/4CX3000A is a ceramic and metal power tetrode designed to be used as a Class-AB_1 linear amplifier in audio or radio-frequency applications. Its characteristics of low intermodulation distortion makes it especially suitable for single sideband service.

This tube is unique in that a production test is included to insure minimum distortion products. The 8169/4CX3000A must produce a minimum of 5300 watts in Class AB_1 service with IM distortion at least 32 db below PEP output.

The tube is also recommended for use as a Class-C radio-frequency power amplifier and plate-modulated radio-frequency power amplifier.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage	-	10	-	volts
Current	43.5	-	48.5	amps
Amplification Factor (Grid Screen)	-	5.5	-	
▶ Frequency For Maximum Ratings	-	-	150	Mc
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	120	-	140	uuf
Output	10.5	-	14.5	uuf
Feedback	-	-	1.4	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Max.	
Input	55	67	uuf
Output	10.5	14.5	uuf
Feedback	-	0.2	uuf

MECHANICAL

Base	Special ring and breechblock terminal surfaces
Maximum Seal Temperature	250°C
Maximum Anode Core Temperature	250°C
Recommended Socket	Eimac SK-1400 series
Recommended Air Chimney	Eimac SK-1406
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	7.9 inches
Diameter	4.6 inches
Cooling	Forced air
Net Weight	5.5 pounds
Shipping Weight (Approximate)	10 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 MAX. VOLTS
DC SCREEN VOLTAGE	1000 MAX. VOLTS
DC PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	3000 MAX. WATTS
SCREEN DISSIPATION	175 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	5000	7000	volts
DC Screen Voltage	500	500	volts
DC Grid Voltage	-280	-300	volts
DC Plate Current	1.9	1.9	amps
DC Screen Current	250	230	mA
DC Grid Current	100	100	mA
Peak RF Grid Voltage	385	405	volts
Driving Power	39	41	watts
Plate Dissipation	1900	2300	watts
Plate Output Power	7600	11,000	watts

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▶ Indicates change from sheet dated 5-1-62

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier Conditions unless noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	5000 MAX. VOLTS
DC SCREEN VOLTAGE	600 MAX. VOLTS
DC PLATE CURRENT	1.4 MAX. AMPS
PLATE DISSIPATION*	2000 MAX. WATTS
SCREEN DISSIPATION	175 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

*Corresponds to 3000 watts at 100 percent sine-wave modulation.

TYPICAL OPERATION

DC Plate Voltage	5000	volts
DC Screen Voltage	500	volts
Peak AF Screen Voltage (For 100% Modulation)	415	volts
DC Grid Voltage	-375	volts
DC Plate Current	1.4	amps
DC Screen Current	170	mA
DC Grid Current	68	mA
Peak RF Grid Voltage	455	volts
Grid Driving Power	31	watts
Plate Dissipation	1250	watts
Plate Output Power	5750	watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	6000 MAX. VOLTS
DC SCREEN VOLTAGE	1000 MAX. VOLTS
DC PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	3500 MAX. WATTS
SCREEN DISSIPATION	175 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

*Per Tube
**Approximate Values

TYPICAL OPERATION (Two Tubes), Class AB_1

DC Plate Voltage	5000	6000 volts
DC Screen Voltage	850	850 volts
DC Grid Voltage*	-180	-200 volts
Max-Signal Plate Current	3.6	3.1 amps
Zero-Signal Plate Current	1.0	0.7 amp
Max-Signal Screen Current**	170	120 mA
Zero-Signal Screen Current	0	0 mA
Peak AF Driving Voltage*	155	175 volts
Driving Power	0	0 watts
Load Resistance, Plate-to-Plate	3000	4160 ohms
Max-Signal Plate Dissipation*	3300	3100 watts
Max-Signal Plate Output Power	11,400	12,400 watts

Note: In Class AB operation, maximum plate voltage and plate current must not be applied simultaneously, as plate dissipation will be exceeded.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	6000 MAX. VOLTS
DC SCREEN VOLTAGE	1000 MAX. VOLTS
DC PLATE CURRENT	2.0 MAX. AMPS
PLATE DISSIPATION	3500 MAX. WATTS
SCREEN DISSIPATION	175 MAX. WATTS
GRID DISSIPATION	50 MAX. WATTS

*Approximate values

These values are obtained in existing equipment. A design test is performed on a sampling basis, insuring that the 4CX3000A will perform as indicated with respect to IM distortion products and power output.

TYPICAL OPERATION
Class AB_1, Grid Driven

DC Plate Voltage	5000	volts
DC Screen Voltage	850	volts
DC Grid Voltage*	180	volts
Zero-Signal DC Plate Current	0.5	amp
Single-Tone DC Plate Current	1.65	amps
Single-Tone DC Screen Current	25	mA
Two-Tone DC Plate Current	1.10	amps
Two-Tone DC Screen Current	20	mA
Peak RF Grid Voltage	155	volts
Driving Power	0	watts
Peak Envelope Useful Output Power	5300	watts
Resonant Load Impedance	1700	ohms
Intermodulation Distortion Products (without negative feedback)	32 or more below PEP level	db

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance is made for circuit losses. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed.

APPLICATION

MECHANICAL

Mounting— The 4CX3000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket— The Eimac SK-1400A and SK-1470A sockets have been designed especially for the 4CX-3000A. The use of recommended air-flow rates through these sockets provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through an Air Chimney, the SK-1406, and through the anode cooling fins.

Cooling— The maximum temperature rating for the external surfaces of the 4CX3000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperature at 200°C in 40°C ambient air are tabulated below (for operation below 30 megacycles).

	SEA LEVEL		10,000 FEET	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
1500	36.5	0.3	53	0.4
2500	60	0.8	88	1.2
3500	86	1.6	125	2.3

*Since the power dissipated by the filament represents about 450 watts and since grid-plus-screen dissipation can, under some conditions, represent another 225 watts, allowance has been made in preparing this tabulation for an additional 675 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation— The rated filament voltage for the 4CX3000A is 10 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

Intermodulation Distortion— The operating conditions including distortion data are the results of actual operation in a neutralized, grid-driven amplifier. This test is performed on sample tubes from regular production runs. A plot of IM distortion versus power output under two-tone condition for a typical tube is shown on the next page.

Control Grid Operation— The rated dissipation of the grid is 50 watts. This is approximately the product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

Screen-Grid Operation— The power dissipated by the screen of the 4CX3000A must not exceed 175 watts.

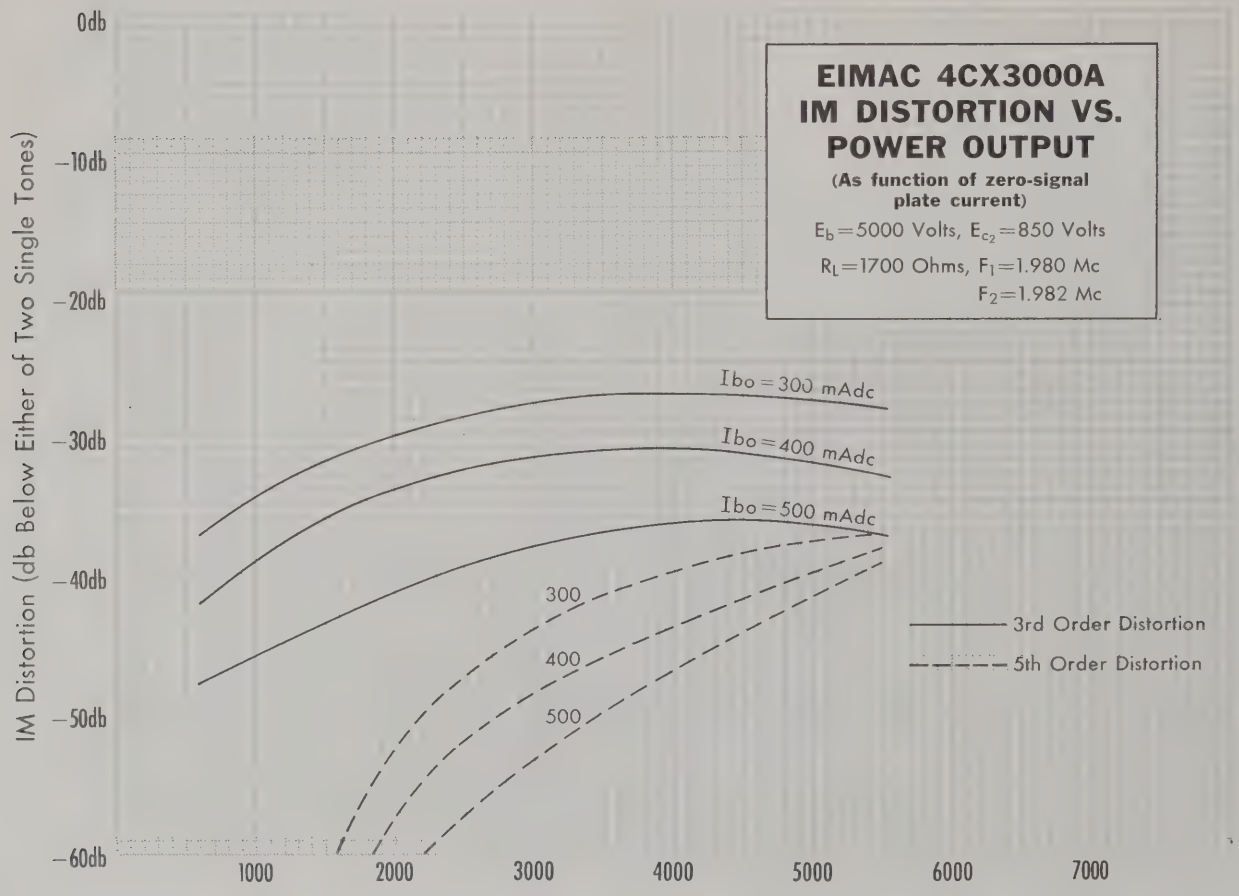
Screen dissipation, in cases where there is no a c applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

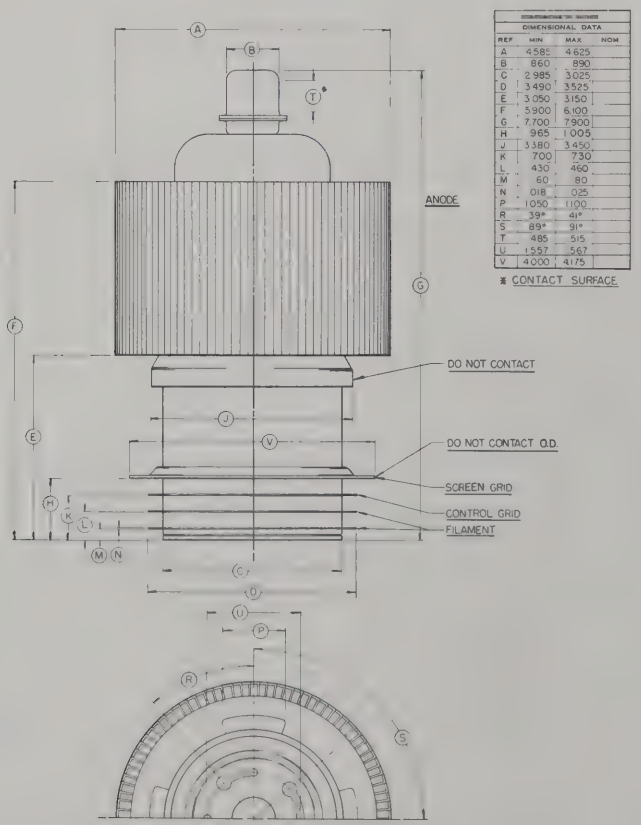
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 175 watts in the event of circuit failure.

Plate Dissipation— The plate-dissipation ratings for the 4CX3000A are 2000 watts for Class-C plate-modulated service and 3000 watts for Class-C telegraphy. In Class-AB operation this rating has been increased to 3500 watts to allow more input. In any Class-AB application maximum plate current and maximum plate voltage should not be applied simultaneously as the plate-dissipation rating would be exceeded.

Special Applications— If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Marketing Department, Eitel-McCullough, Inc. 301 Industrial Way, San Carlos, California, for information and recommendations.

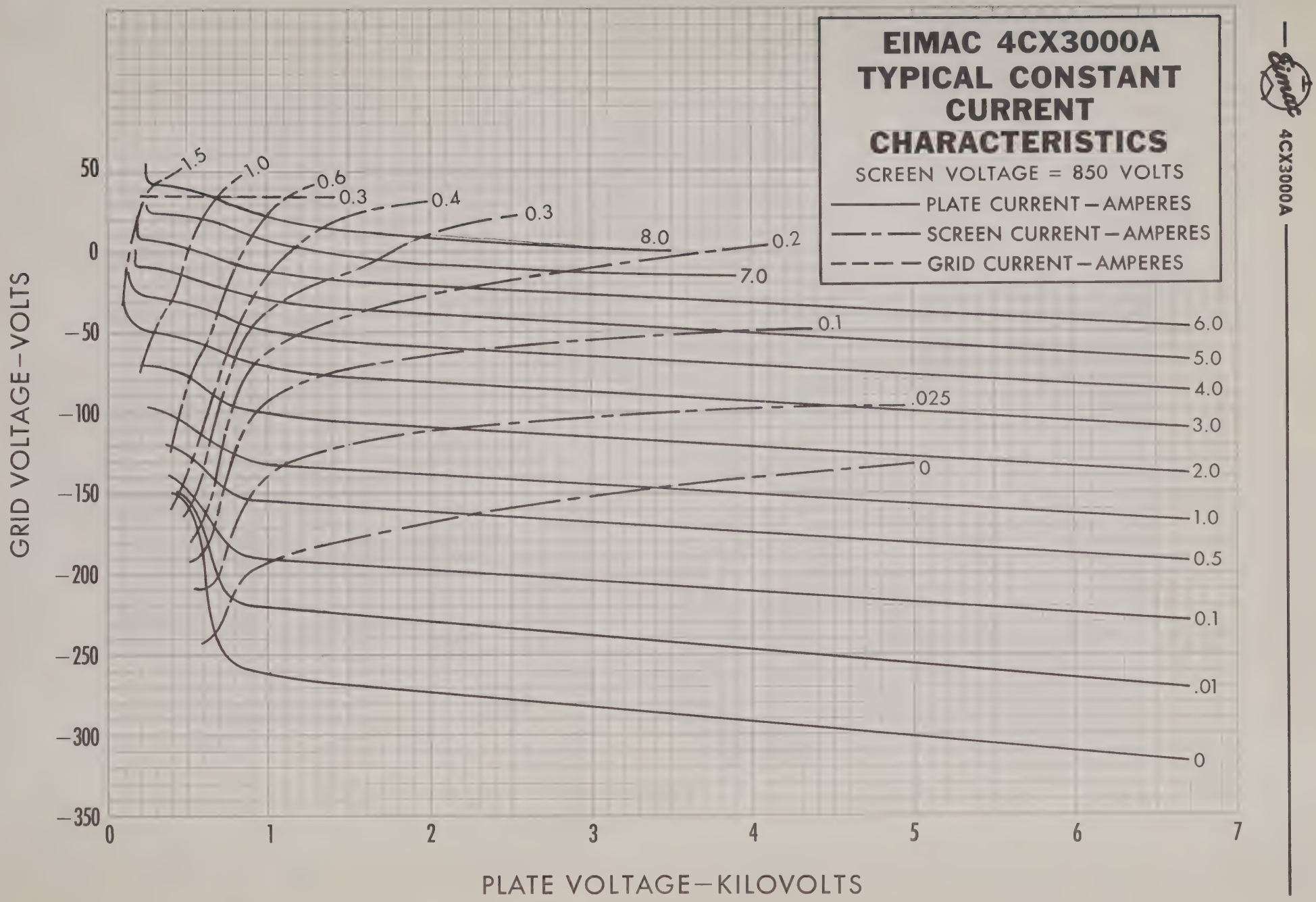
▶ Indicates change from sheet dated 5-1-62

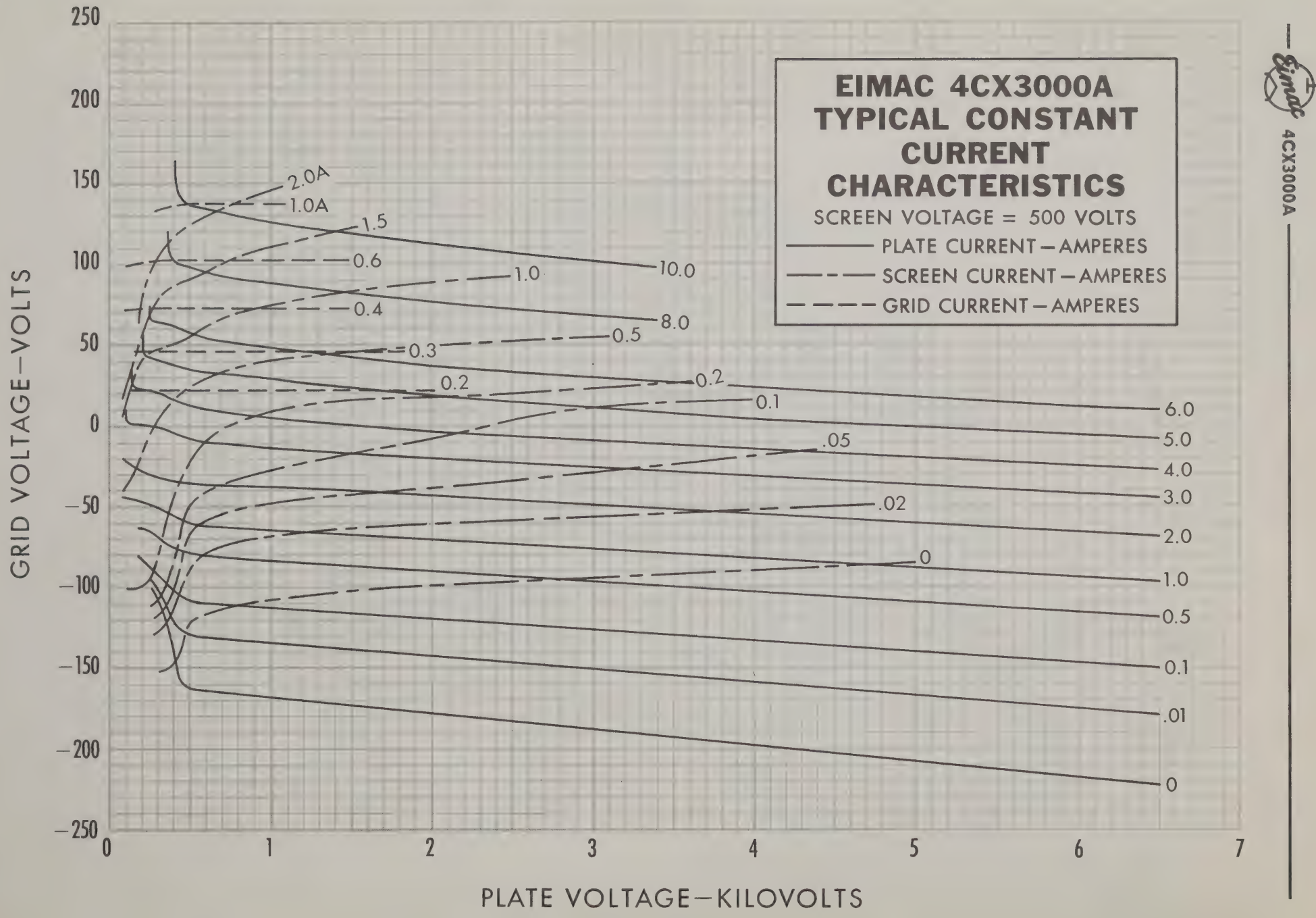




DIMENSIONAL DATA

REF	MIN	MAX	NOM
A	4585	4625	
B	860	890	
C	2.985	3025	
D	3490	3525	
E	3.050	3150	
F	5900	6.100	
G	7.700	7900	
H	965	1005	
J	3380	3450	
K	700	730	
L	430	460	
M	60	80	
N	018	025	
P	1050	1100	
R	39°	41°	
S	89°	91°	
T	485	515	
U	1557	567	
V	4000	4175	


EIMAC 4CX3000A
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 850 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
50
0
−50
−100
−150
−200
−250
−300
−350
0
1
2
3
4
5
6
7
1.5
1.0
0.6
0.3
0.4
0.3
8.0
0.2
7.0
0.1
6.0
5.0
4.0
.025
3.0
0
2.0
1.0
0.5
0.1
.01
0


EIMAC 4CX3000A
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
250
200
150
100
50
0
−50
−100
−150
−200
−250
0
1
2
3
4
5
6
7
2.0A
1.0A
1.5
0.6
1.0
0.4
0.5
0.3
0.2
0.2
0.1
.05
.02
0
10.0
8.0
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.1
.01
0

EITEL-McCULLOUGH, INC.

8170
4CX5000A

RADIAL-BEAM POWER TETRODE



The Eimac 8170/4CX5000A is a compact high-power ceramic and metal tetrode cooled by forced air. It is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megacycles and is particularly suited for use as a linear single-sideband amplified, class-AB1 audio amplifier, or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The rated plate dissipation is five kilowatts for most classes of services and six kilowatts for class-AB operation.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amperes
Amplification Factor (Grid-Screen)		4.5		
▶ Direct Interelectrcde Capacitances, Grounded Cathode:				
Input	108		122	uuf
Output	18		23	uuf
Feedback			1.0	uuf

▶ Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Max.	
Input	48	58	uuf
Output	18	23	uuf
Feedback		0.16	uuf

MECHANICAL

Base	Special concentric
Maximum Seal Temperature	250° C
Maximum Anode-Core Temperature	250° C
Recommended Socket	Eimac SK-300A
Recommended Chimney	Eimac SK-306
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	9.13 inches
Diameter	4.94 inches
Cooling	Forced air
Net Weight	9.5 pounds
Shipping Weight (Approximate)	22 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 30 megacycles)

Class-C Telegraphy (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	3 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION

(Frequencies below 30 megacycles)

D-C Plate Voltage	7500 volts
D-C Screen Voltage	500 volts
D-C Grid Voltage	—350 volts
D-C Plate Current	2.8 amperes
D-C Screen Current	0.5 ampere
D-C Grid Current	0.25 ampere
Peak R-F Grid Voltage	590 volts
Driving Power	150 watts
Plate Dissipation	5000 watts
Plate Output Power	16,000 watts

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RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR (From 30 to 110 megacycles)

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
30 to 60 megacycles	7000 MAX. VOLTS
60 to 110 megacycles	6500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT:	
30 to 60 megacycles	2.8 MAX. AMPERES
60 to 110 megacycles	2.6 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies between 88 and 108 megacycles)

D-C Plate Voltage	6500	volts
D-C Screen Voltage	750	volts
D-C Grid Voltage	—350	volts
D-C Plate Current	2.3	amperes
D-C Screen Current	0.2	ampere
D-C Grid Current	0.05	ampere
Driving Power	25	watts
Useful Output Power	10,000	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPERES
PLATE DISSIPATION*	3500 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

*Corresponds to 5000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megacycles)

D-C Plate Voltage	5000	volts
D-C Screen Voltage	500	volts
Peak A-F Screen Voltage (For 100-percent modulation)	450	volts
D-C Grid Voltage	—400	volts
D-C Plate Current	1.4	amperes
D-C Screen Current	0.26	ampere
D-C Grid Current	0.05	ampere
Peak R-F Grid Voltage	520	volts
Grid Driving Power	25	watts
Plate Dissipation	1100	watts
Plate Output Power	5.8	kilowatts

SCREEN-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

(Carrier conditions except where noted)

MAXIMUM RATINGS, Class-C Telephony (Per Tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C PLATE CURRENT	3.0 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 megacycles, per tube)

D-C Plate Voltage	7500	7500	volts
D-C Screen Voltage	350	350	volts
Peak A-F Screen Voltage (For 100-percent modulation)	550	550	volts
D-C Grid Voltage	—300	—300	volts
D-C Plate Current	0.9	1.14	amperes
D-C Screen Current*	—0.01	—0.01	ampere
D-C Grid Current	0.015	0.03	ampere
Peak R-F Grid Voltage	350	375	volts
Grid Driving Power	7	11	watts
R-F Load Impedance	2000	1600	ohms
Plate Dissipation	4000	5000	watts
Useful Output Power	2750	3550	watts

*D-C Screen Current is a function of loading; values of plus or minus 20 milliamperes may be considered typical at carrier level.

NOTE: Two tubes can be employed under conditions listed in the first column to obtain more than five kilowatts plate output power. Likewise, three tubes can be utilized at conditions listed in the second column to obtain better than ten kilowatts output power.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, two tubes

D-C Plate Voltage	4000	5000	6000	7000	volts
D-C Screen Voltage	1250	1250	1250	1250	volts
D-C Grid Voltage	—270	—280	—310	—325	volts
Max.-Signal Plate Current	5.10	4.40	4.25	3.65	amperes
Zero-Signal Plate Current	1.25	1.00	0.83	0.70	amperes
Max-Signal Screen Current	0.35	0.33	0.30	0.24	ampere
Zero-Signal Screen Current	0	0	0	0	amperes
Peak A-F Driving Voltage	250	240	270	235	volts
Driving Power	0	0	0	0	watts
Load Resistance, Plate-to-Plate	1500	2370	2940	4100	ohms
Max.-Signal Plate Dissipation	4200	4200	4200	4200	watts
Max.-Signal Plate Output Power	11,500	13,500	17,000	17,500	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions, (Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	1250	volts
D-C Grid Voltage*	—300	volts
Max.-Signal Plate Current	1.9	amperes
Zero-Signal Plate Current	0.50	ampere
Max.-Signal Screen Current	0.20	ampere
Peak R-F Grid Voltage	300	volts
Driving Power	0	watts
Plate Dissipation	4200	watts
Plate Output Power**	10,000	watts

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or r-f output power at crest of modulation envelope.

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MECHANICAL

Mounting—The 4CX5000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—The Eimac SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5OOOA. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

Cooling—The maximum temperature rating for the external surfaces of the 4CX5000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Sea level air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

	SK-300A Socket		SK-300 Socket	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
2000	75	0.4	75	0.4
3000	105	0.7	100	0.7
4000	145	1.1	135	1.2
5000	190	1.5	165	1.8
6000	230	2.0	200	2.5

*Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX5000A is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4CX5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

Control Grid Operation— The 4CX5000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

Screen-Grid Operation—The power dissipated by the screen of the 4CX5000A must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

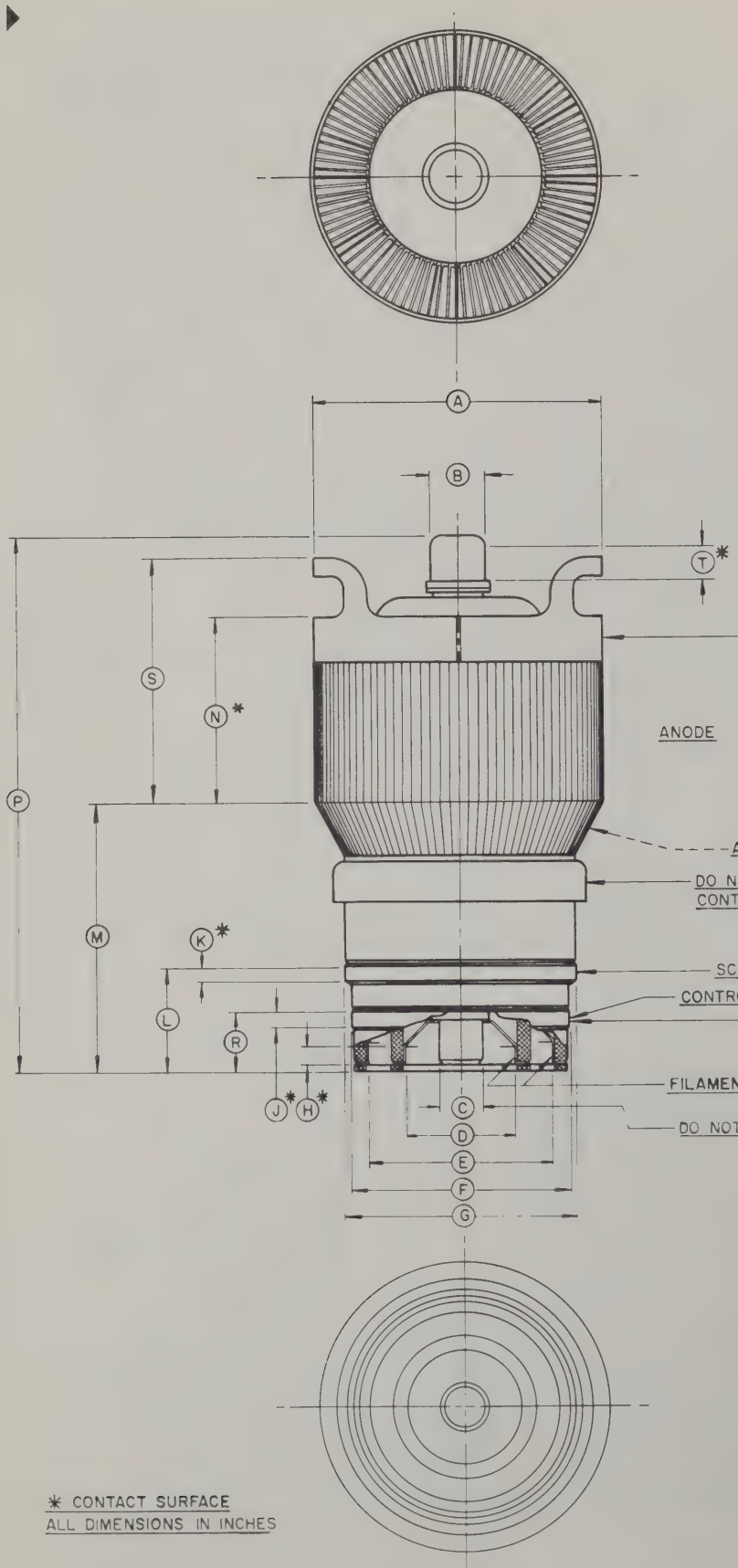
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

Plate Dissipation—The plate-dissipation rating for the 4CX5000A is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts.

When the 4CX5000A is operated as a plate-modulated r-f power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

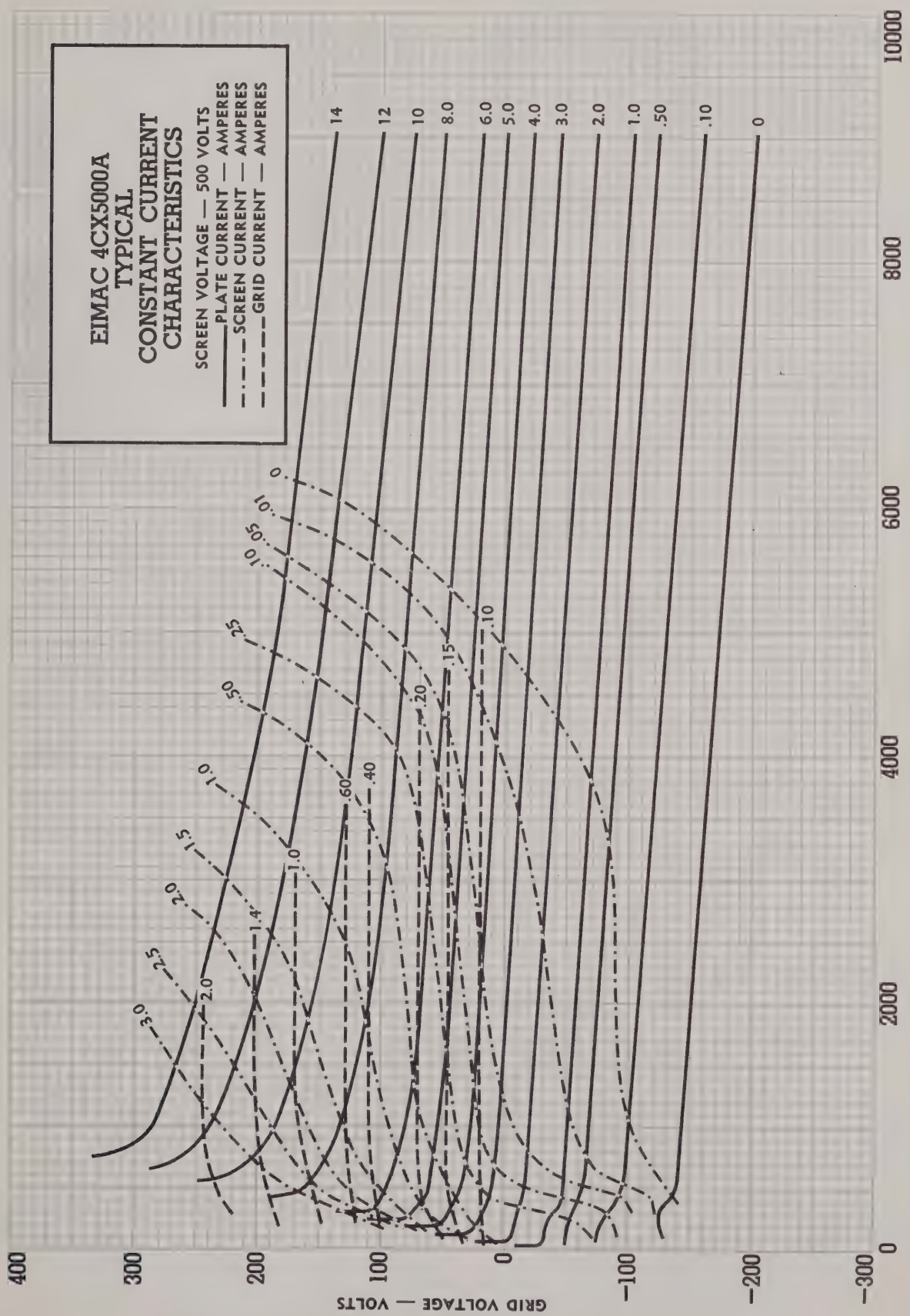
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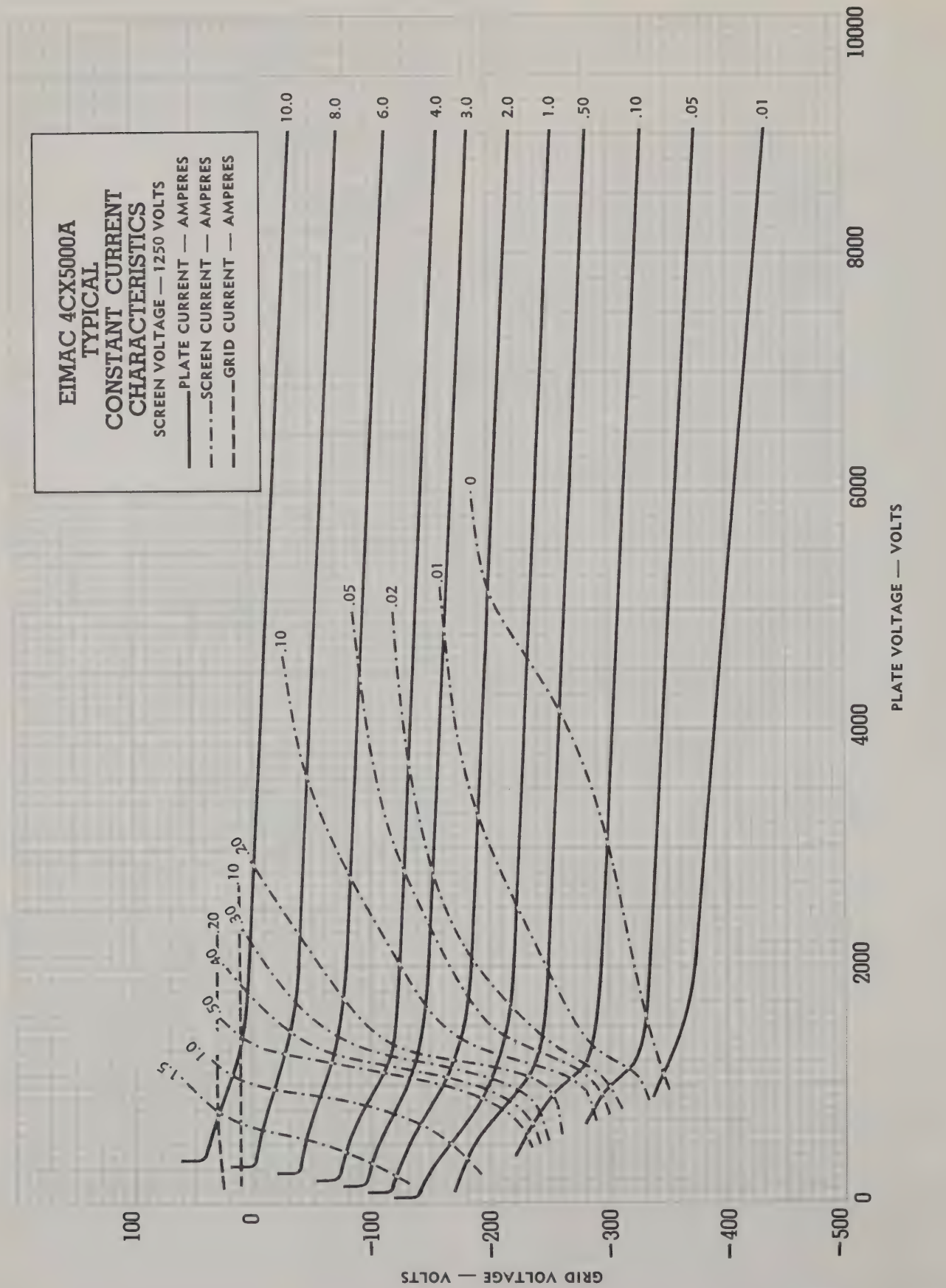


DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		4.812	4.938
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
G		3.980	4.020
H		.188	
J		.188	
K		.188	
L		1.764	1.826
M		4.188	4.563
N		2.875	3.250
P		8.625	9.125
R		.986	1.050
S		3.875	4.250
T		.375	

* CONTACT SURFACE
ALL DIMENSIONS IN INCHES

▶ Indicates change from sheet dated 3-15-60


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
14
12
10
8.0
6.0
5.0
4.0
3.0
2.0
1.0
.50
.10
0
3.0
2.5
2.0
1.5
1.0
.5
.25
.10
.05
.01
0
1.4
1.0
.60
.40
.20
.15
.10
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS



Printed in U.S.A. 5415

TECHNICAL DATA

8170W
4CX5000R

RADIAL-BEAM
POWER TETRODE

The EIMAC 8170W/4CX5000R is a compact, high-power, ceramic/metal tetrode. It is directly interchangeable with the 8170/4CX5000A but incorporates more rugged internal construction features, including a sturdy mesh cathode, which allows it to meet demanding vibration and shock specifications.

The 8170W/4CX5000R is useful up to 110 Mc and is recommended for use as a radio-frequency linear amplifier, a Class-AB audio amplifier, or a Class-C power amplifier or plate-modulated amplifier.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	7.5 ± 0.37	V
Current, at 7.5 volts	75	A
Amplification Factor (Average):		
Grid to Screen	4.5	
Direct Interelectrode Capacitance (grounded filament)[2]		
Cin	115	pF
Cout	20	pF
Cgp	0.7	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Cin	53	pF
Cout	22.5	pF
Cpk	0.10	pF
Frequency of Maximum Rating:		
CW	100	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	9.125 in;231.77 mm
Diameter	4.938 in;125.43 mm
Net Weight	9.5 lb; 4.31 kg
Operating Position	Axis vertical, base up or down

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Maximum Operating Temperature:
Ceramic/Metal Seals or Anode Core . . . . . 250°C
Cooling . . . . . Forced Air
Base . . . . . Special concentric
Recommended Air System Socket . . . . . SK-300 or SK-300A
Recommended (Air) Chimney SK-306

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB_1

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	7500	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	6000	WATTS
SCREEN DISSIPATION	250	WATTS
GRID DISSIPATION	75	WATTS

TYPICAL OPERATION (Frequencies to 100 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	7500	Vdc
Screen Voltage	1250	Vdc
Grid Voltage [1]	-300	Vdc
Zero-Signal Plate Current	0.50	Adc
Single-Tone Plate Current	1.90	Adc
Single-Tone Screen Current [2]	0.20	Adc
Peak rf Grid Voltage [2]	300	v
Plate Dissipation	4200	W
Single-Tone Plate Output Power	10,000	W

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7500	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT	3.0	AMPERES
PLATE DISSIPATION	5000	WATTS
SCREEN DISSIPATION	250	WATTS
GRID DISSIPATION	75	WATTS

TYPICAL OPERATION (Frequencies to 100 MHz)

Plate Voltage	6500	Vdc
Screen Voltage	750	Vdc
Grid Voltage	-350	Vdc
Plate Current	2.30	Adc
Screen Current [1]	0.20	Adc
Grid Current [1]	0.05	Adc
Measured Driving Power [1]	100	W
Useful Output Power	10,000	W

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	5000	VOLTS
DC SCREEN VOLTAGE	1000	VOLTS
DC PLATE CURRENT	2.5	AMPERES
PLATE DISSIPATION [1]	3500	WATTS
SCREEN DISSIPATION [2]	250	WATTS
GRID DISSIPATION [2]	75	WATTS

1. Corresponds to 5000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 100 MHz)

Plate Voltage	5000	Vdc
Screen Voltage	500	Vdc
Grid Voltage	-400	Vdc
Plate Current	1.40	Adc
Screen Current [1]	0.26	Adc
Grid Current [1]	0.05	Adc
Peak af Screen Voltage [1] (100% modulation)	450	v
Peak rf Grid Voltage [1]	520	v
Calculated Driving Power	25	W
Plate Dissipation	1200	W
Plate Output Power	5800	W

1. Approximate value

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB_1, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	7500	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	6000	WATTS
SCREEN DISSIPATION	250	WATTS
GRID DISSIPATION	75	WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	4000	5000	6000	7000	Vdc
Screen Voltage	1250	1250	1250	1250	Vdc
Grid Voltage 1/4	-270	-280	-310	-325	Vdc
Zero-Signal Plate Current	1.25	1.00	0.83	0.70	Adc
Max. Signal Plate Current	5.10	4.40	4.25	3.65	Adc
Max. Signal Screen Current[1]	0.35	0.33	0.30	0.24	Adc
Peak af Grid Voltage[2]	250	240	270	235	v
Max. Signal Plate Dissipation[1]	4200	4200	4200	4200	W
Plate Output Power	11,500	13,500	17,000	17,500	W
Load Resistance (plate to plate)	1500	2370	2940	4100	Ω

1. Approximate value.
2. Per Tube.
3. Nominal drive power is one-half peak power.
4. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 7.5 volts	73	78	A
Interelectrode Capacitances[1] (grounded filament connection)			
Cin	108	122	pF
Cout	18	23	pF
Cgp	---	1.0	pF
Interelectrode Capacitances[1] (grounded grid connection)			
Cin	48	58	pF
Cout	19	24	pF
Cpk	---	0.16	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CX5000R must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5000R. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

COOLING - The maximum temperature rating for the external surfaces of the 4CX5000R is 250°C. Sufficient forced-air circulation must be

provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Sea level air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

	SK-300A Socket		SK-300 Socket	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
2000	75	0.4	75	0.4
3000	105	0.7	100	0.7
4000	145	1.1	135	1.2
5000	190	1.5	165	1.8
6000	230	2.0	200	2.5

Since the power dissipated by the filament represents about 560 watts and since grid-plus screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

IMPACT AND VIBRATION - The 4CX5000R is designed to operate under shock and vibration that might disable a less rugged tube. Up to 50 g of impact of 11 millisecond duration can be sustained and vibratory acceleration up to 5 g from 14 to 200 Hz and 2 g from 200 to 500 Hz will not ordinarily injure the tube unless prolonged. Production tubes are subjected to testing to insure this ruggedness.

ELECTRICAL

FILAMENT VOLTAGE - The rated filament voltage for the 4CX5000R is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

GRID DISSIPATION - The 4CX5000R control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. Grid Dissipation is approximately the product of dc grid current and peak positive grid voltage. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

SCREEN DISSIPATION - The power dissipated by the screen of the 4CX5000R must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX5000R is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts. Plate dissipation may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

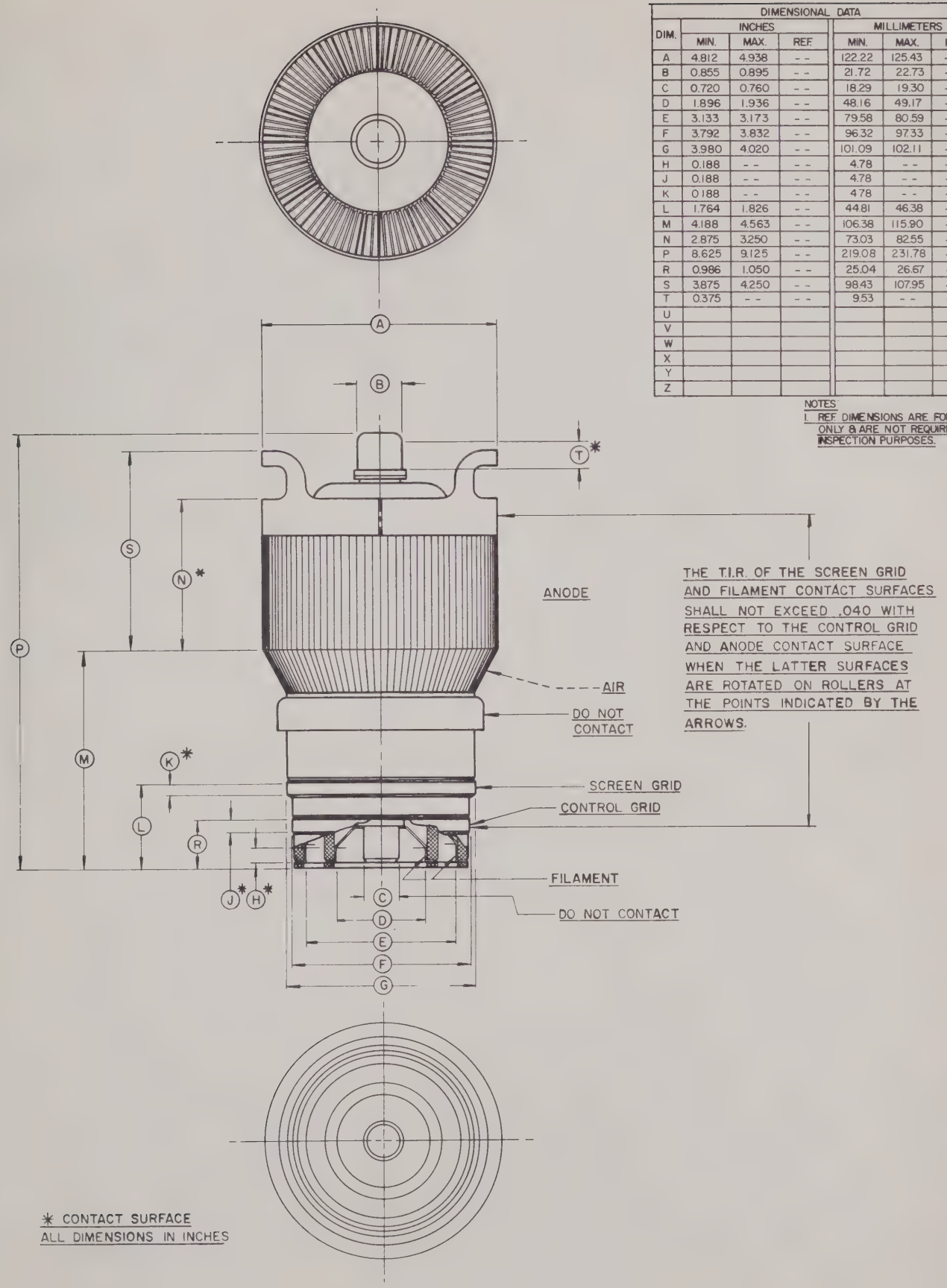
When the 4CX5000R is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

HIGH VOLTAGE - The 4CX5000R operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

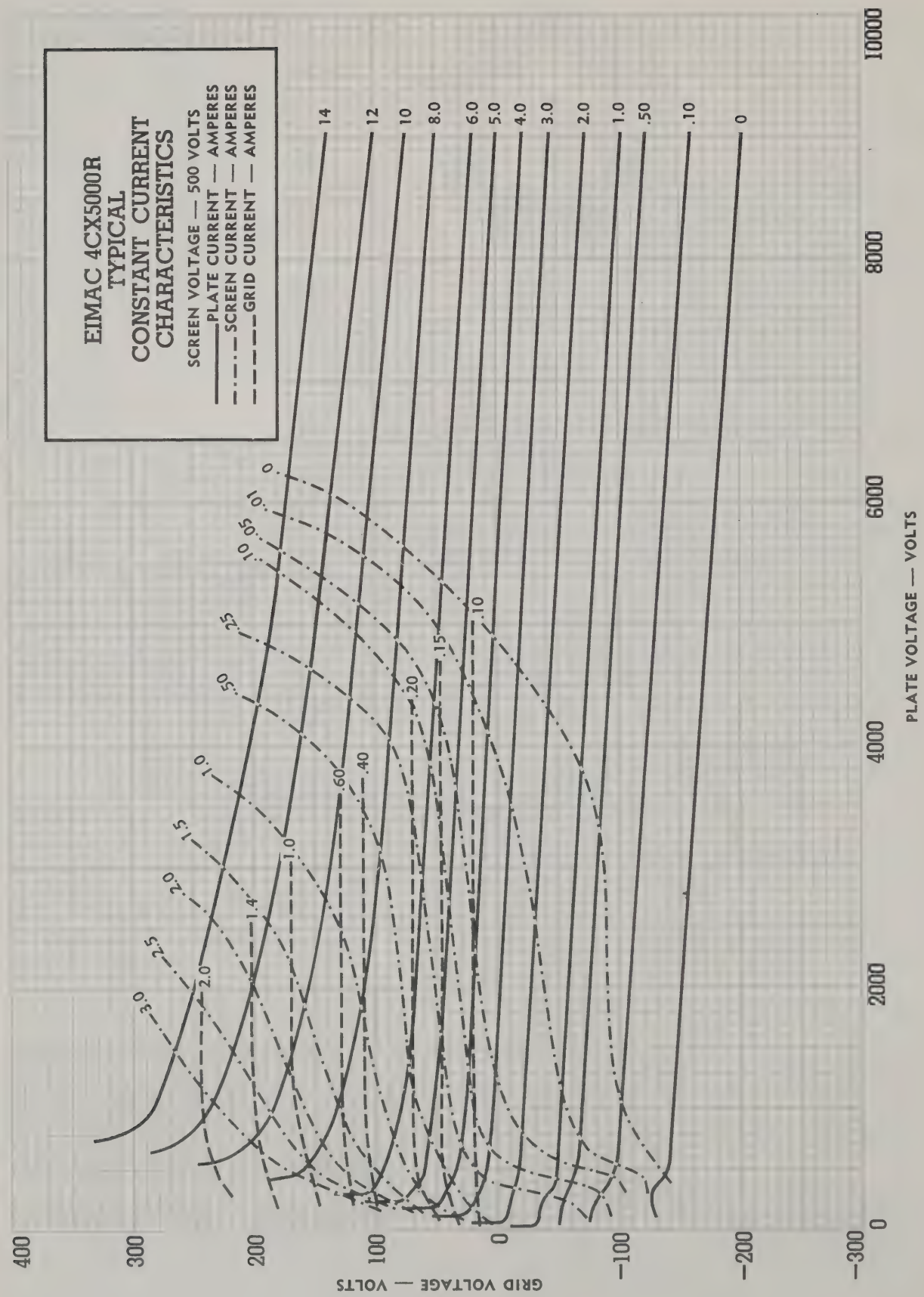
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

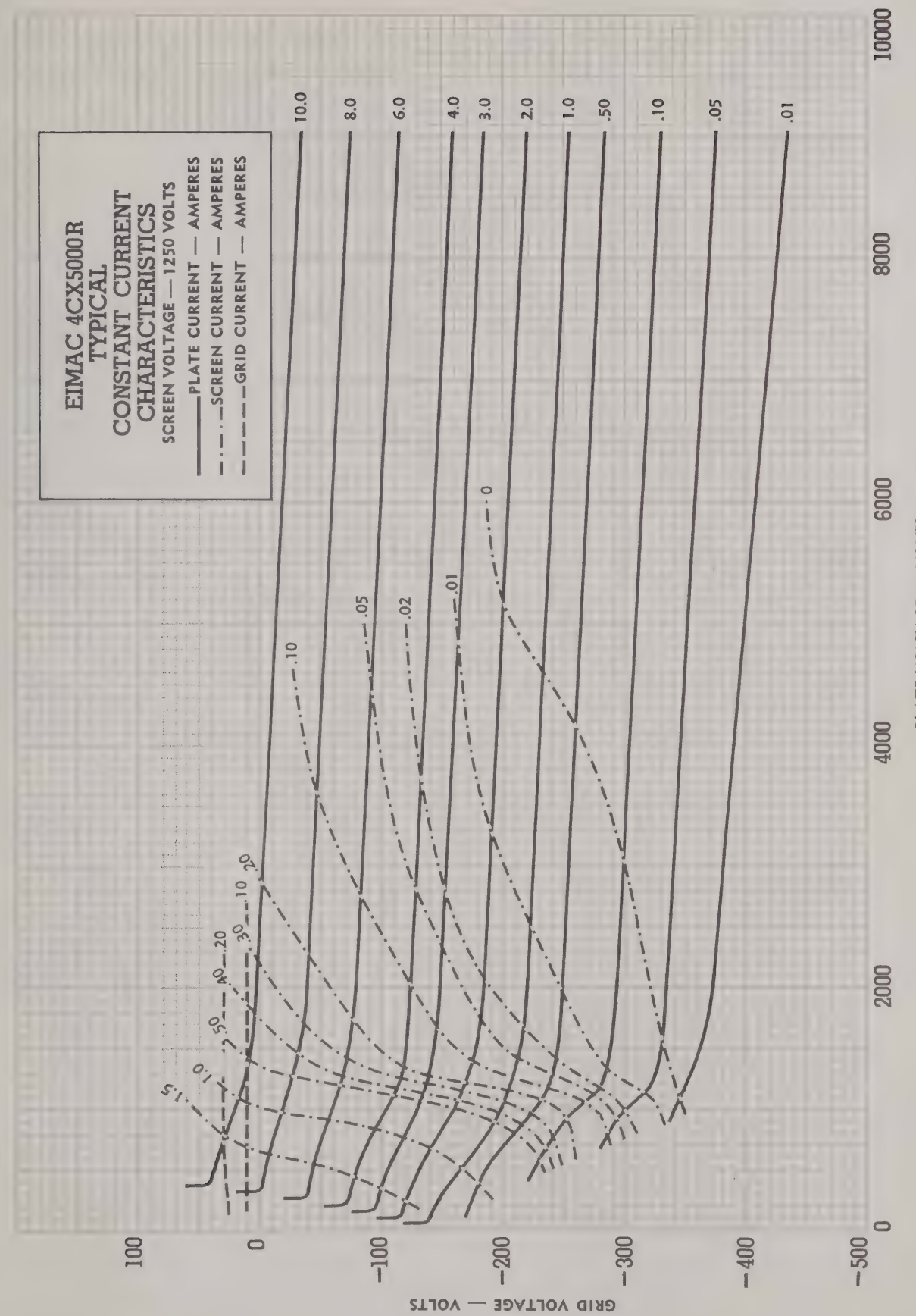
DIM.	DIMENSIONAL DATA					
	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.812	4.938	- -	122.22	125.43	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
G	3.980	4.020	- -	101.09	102.11	- -
H	0.188	- -	- -	4.78	- -	- -
J	0.188	- -	- -	4.78	- -	- -
K	0.188	- -	- -	4.78	- -	- -
L	1.764	1.826	- -	44.81	46.38	- -
M	4.188	4.563	- -	106.38	115.90	- -
N	2.875	3.250	- -	73.03	82.55	- -
P	8.625	9.125	- -	219.08	231.78	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.875	4.250	- -	98.43	107.95	- -
T	0.375	- -	- -	9.53	- -	- -
U						
V						
W						
X						
Y						
Z						

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.



* CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 4CX5000R
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
14
12
10
8.0
6.0
5.0
4.0
3.0
2.0
1.0
.50
.10
0
3.0
2.5
2.0
1.5
1.0
.5
.25
.10
.05
0
1.4
1.0
.60
.40
.20
.15
.10


EIMAC 4CX5000R
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 1250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.50
.10
.05
.01
.10
.05
.02
.01
0
100
0
−100
−200
−300
−400
−500
0
2000
4000
6000
8000
10000
PLATE VOLTAGE — VOLTS
GRID VOLTAGE — VOLTS

TECHNICAL DATA

8349
4CX35,000C

RADIAL-BEAM
POWER TETRODE

The EIMAC 8349/4CX35,000C is a ceramic/metal, forced-air cooled power tetrode intended for use at the 50 to 150 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB rf linear amplifier, or a Class-AB push-pull af amplifier or modulator. The 8349/4CX35,000C is also useful as a plate and screen modulated Class-C rf amplifier.

The forced-air cooled anode is rated at 35 kilowatts maximum dissipation.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	10.0 V
Current, at 10.0 volts	295 A
Amplification Factor (Average):	
Grid to Screen	4.5
Direct Interelectrode Capacitances (grounded cathode)[2]	
Cin	440 pF
Cout	55 pF
Cgp	2.3 pF
Frequency of Maximum Rating:	
CW	30 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	17.34 in; 440.4 mm
Diameter	9.75 in; 247.7 mm
Net Weight	50 lb; 22.7 kg
Operating Position	Vertical, base up or down
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C
Cooling	Forced Air
Base	Special, graduated rings
Recommended Socket	EIMAC SK-1500

(Revised 12-1-70) © 1963, 1967, 1970 by Varian

Printed in U.S.A.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB

MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	15.0	kVdc
Screen Voltage	1.5	kVdc
Grid Voltage [1]	-400	Vdc
Zero-Signal Plate Current	1.0	Adc
Single Tone Plate Current	5.7	Adc
Single-Tone Screen Current [2]	0.9	Adc
Peak rf Grid Voltage [2]	250	v
Peak Driving Power [2]	0	w
Plate Dissipation	30	kW
Plate Output Power	55	kW
Resonant Load Impedance	1280	Ω

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	10.0	15.0	19.0	kVdc
Screen Voltage	750	750	750	Vdc
Grid Voltage	-425	-480	-550	Vdc
Plate Current	7.5	6.8	6.96	Adc
Screen Current [1]	0.84	0.51	0.80	Adc
Grid Current [1]	0.29	0.23	0.35	Adc
Peak rf Grid Voltage [1]	600	660	730	v
Calculated Driving Power [1]	180	150	258	W
Plate Dissipation	19.3	19.0	21.0	kW
Plate Output Power	55.5	82.5	110	kW

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	14,000	VOLTS
DC SCREEN VOLTAGE	2000	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION [1]	23,000	WATTS
SCREEN DISSIPATION [2]	1750	WATTS
GRID DISSIPATION [2]	500	WATTS

1. Corresponds to 35,000 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	12.0	kVdc
Screen Voltage	750	Vdc
Grid Voltage	-600	Vdc
Plate Current	5.4	Adc
Screen Current [1]	0.52	Adc
Grid Current [1]	0.16	Adc
Peak af Screen Voltage [2] (100% modulation)	500	v
Peak rf Grid Voltage [1]	740	v
Calculated Driving Power	125	W
Plate Dissipation	13.2	kW
Plate Output Power	55.0	kW
Resonant Load Impedance	1120	Ω

1. Approximate value.
2. Approximate value, depending upon degree of driver modulation.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR
Class AB, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE	20,000	VOLTS
DC SCREEN VOLTAGE	2,500	VOLTS
DC PLATE CURRENT	15.0	AMPERES
PLATE DISSIPATION	35,000	WATTS
SCREEN DISSIPATION	1750	WATTS
GRID DISSIPATION	500	WATTS

1. Approximate value.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	12.0	kVdc
Screen Voltage	1.5	kVdc
Grid Voltage[1/3]	-400	Vdc
Zero-Signal Plate Current	3.0	Adc
Max Signal Plate Current	9.2	Adc
Max Signal Screen Current[1]	1.8	Adc
Peak af Grid Voltage[2]	280	v
Max Signal Plate Dissipation[2]	20	kW
Plate Output Power	70	kW
Load Resistance (plate to plate)	2860	Ω

2. Per Tube
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 10.0 volts	280	310	A
Interelectrode Capacitances (grounded cathode connection)[2]			
Cin	410	470	pF
Cout	50	60	pF
Cgp	1.5	3.2	pF

2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CX35,000C must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC sockets, type SK-1500, and SK-1510 have been designed especially for the concentric base terminals of the 4CX35,000C.

COOLING - The maximum temperature rating for the external surfaces of the 4CX35,000C is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C.

Air-flow requirements to maintain core temperature at 225°C in 40° ambient air are tabulated below (for operation below 30 megahertz.) These data are for air flowing in the base-to-anode direction.

	Base-to-Anode Air Flow			
	Sea Level		10,000 Feet	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
15,000	554	1.2	795	1.7
20,000	820	2.1	1100	3.0
25,000	1140	3.6	1665	5.2
30,000	1465	5.0	2140	7.4
35,000	1800	7.2	2630	10.3

* Since the power dissipated by the filament represents about 3000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 2250 watts, allowance has been made in preparing this tabulation for an additional 5250 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

Separate cooling of the tube base is required and is accomplished by directing approximately 120 cfm of air horizontally through the socket from the side. It is preferable to direct this air through three equally spaced ducts.

The well in the center of the baseplate of the tube is a critical area which requires cooling to maintain envelope temperatures less than 250°C. For most applications, 1 to 2 CFM of air directed through the center of the socket is sufficient for this purpose.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The peak emission at rated filament voltage of the EIMAC 4CX35,000C is normally many times the peak emission required for communication service. A small decrease in filament temperature due to reduction of filament voltage can increase the life of the 4CX35,000C by a substantial percentage. It is good practice to determine the nominal filament voltage for a particular application that will not affect the operation of the equipment. This is done by measuring some important parameter of performance such as plate current, power output, or distortion while filament voltage is reduced on the 4CX35,000C. At some point in filament voltage there will be a noticeable reduction in plate current, or power output, or an increase in distortion. Operation may be at a filament voltage slightly higher than that point at which performance appears to deteriorate. This voltage should be measured at the socket with a 1% meter and periodically checked to maintain proper operation.

Filament starting current must be limited to a maximum of 900 amperes.

Voltage between filament and the base plates of tube and SK-1500 socket, must not exceed 100 volts.

GRID OPERATION - The 4CX35,000C grid has a maximum dissipation rating of 500 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

SCREEN OPERATION - The power dissipated by the screen of the 4CX35,000C must not exceed 1750 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 1750 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX35,000C is 35,000 watts. When the 4CX35,000C is operated as a plate-modulated rf amplifier, under carrier conditions, the maximum plate dissipation is 23,000 watts.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capaci-

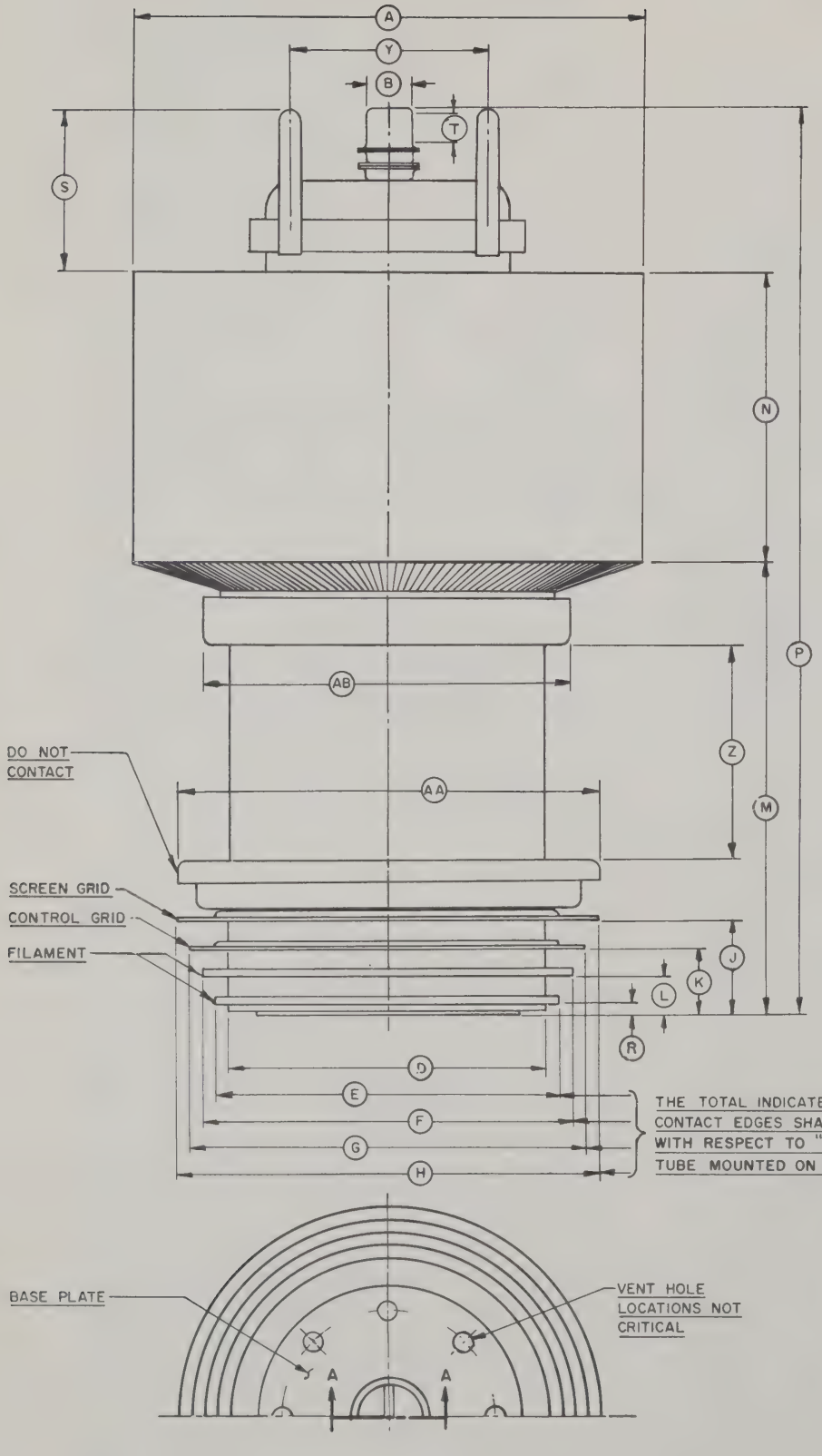
tance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - Normal operating voltages used with the 4CX35,000C are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

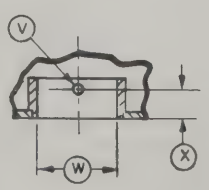
X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CX35,000C, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.

Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

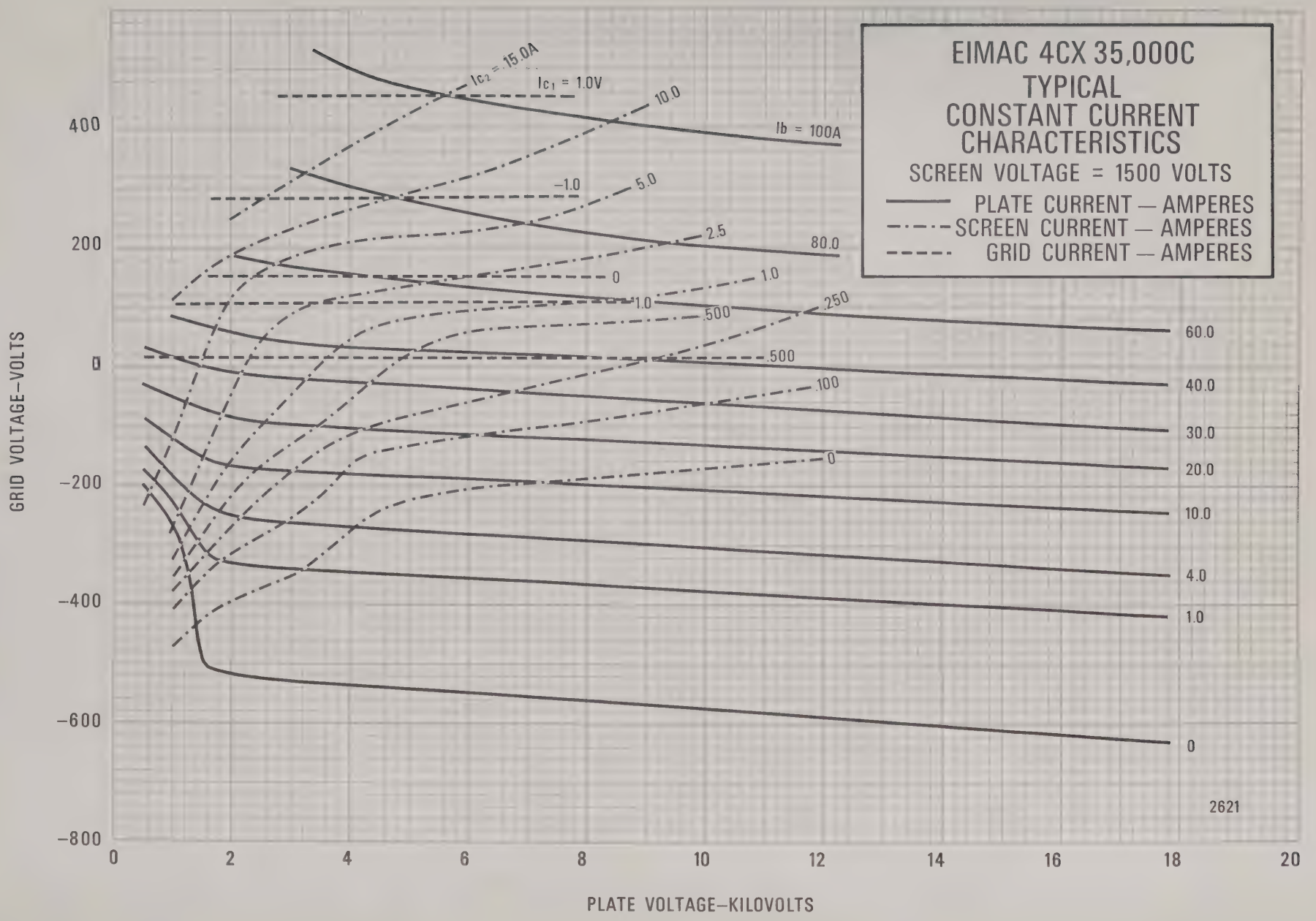
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Product Manager, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.

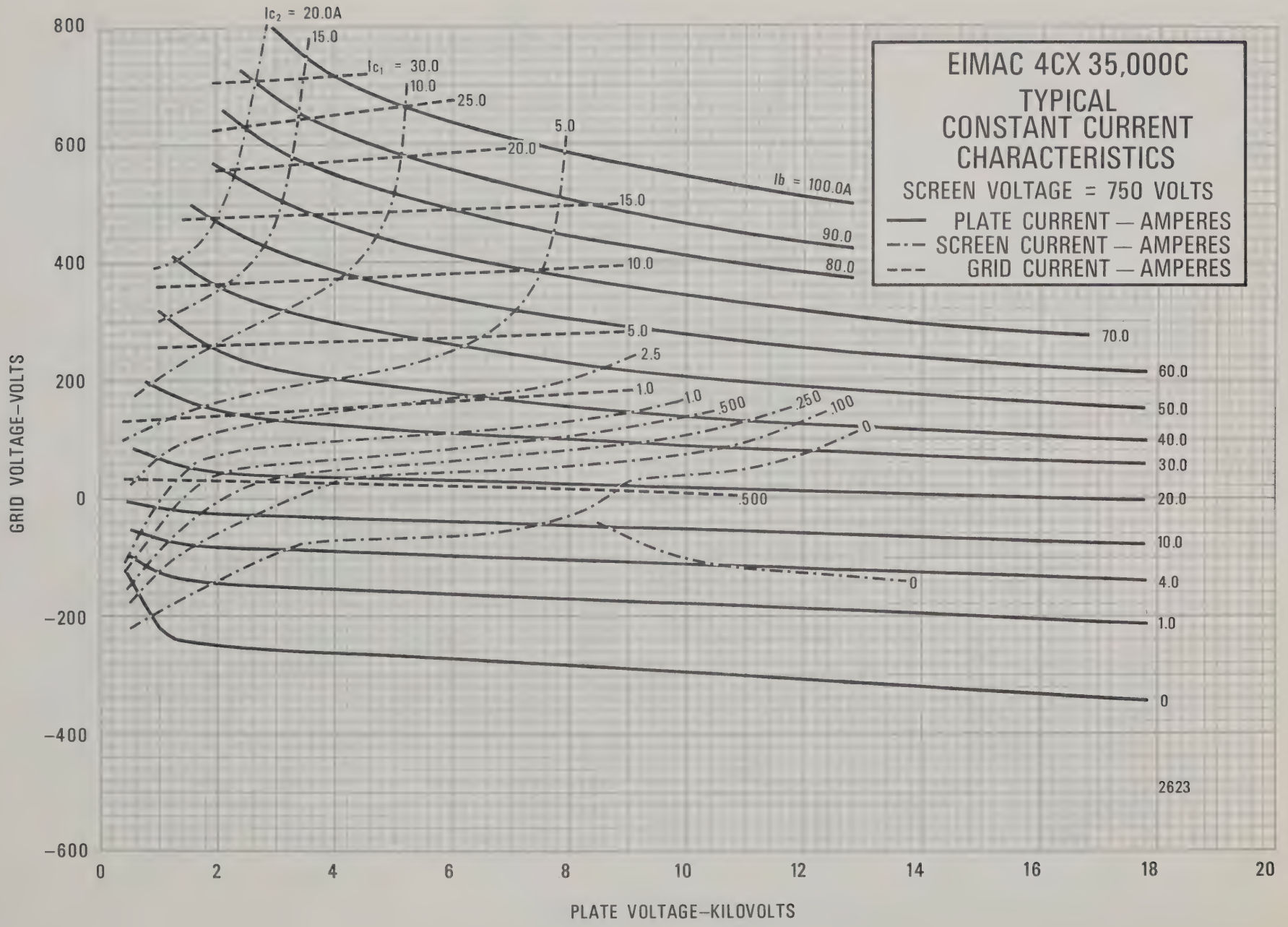


DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	9.500	9.750	241.30	247.65
B	0.860	0.890	21.84	22.60
D	5.980	6.020	151.89	152.91
E	6.510	6.560	165.35	166.62
F	6.980	7.020	177.29	178.31
G	7.480	7.520	189.99	191.01
H	7.975	8.015	202.57	203.58
J	1.750	1.800	44.45	45.72
K	1.220	1.270	30.99	32.26
L	0.690	0.740	17.53	18.80
M	8.442	8.692	214.43	220.78
N	5.375	5.625	136.52	142.88
P	17.070	17.340	433.58	440.44
R	0.173	0.213	4.40	5.41
S	3.062 (1)		77.77 (1)	
T	0.485	0.515	12.32	13.08
V	— —	0.135	— —	3.43
W	1.250	1.270	31.75	32.26
X	0.490	0.530	12.45	13.46
Y	4.500 (1)		114.30 (1)	
Z	3.750 (1)		95.25 (1)	
AA	8.000 (1)		203.20 (1)	
AB	6.875 (1)		174.63 (1)	



SECTION A–A
ROTATED 180°


EIMAC 4CX 35,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE–VOLTS
PLATE VOLTAGE–KILOVOLTS
400
200
0
−200
−400
−600
−800
0
2
4
6
8
10
12
14
16
18
20
Ic2 = 15.0A
Ic1 = 1.0V
Ib = 100A
10.0
5.0
2.5
1.0
.500
.250
.100
0
−1.0
80.0
60.0
40.0
30.0
20.0
10.0
4.0
1.0
0
2621


EIMAC 4CX 35,000C
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
Ic2 = 20.0A
15.0
Ic1 = 30.0
10.0
25.0
5.0
20.0
15.0
10.0
5.0
2.5
1.0
1.0
.500
.250
.100
0
.500
0
Ib = 100.0A
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
4.0
1.0
0
2623
800
600
400
200
0
−200
−400
−600
0
2
4
6
8
10
12
14
16
18
20
GRID VOLTAGE–VOLTS
PLATE VOLTAGE–KILOVOLTS

8876

TECHNICAL DATA

RADIAL-BEAM
POWER TETRODE

The 8876 is a ceramic/metal forced-air cooled, external-anode radial-beam tetrode with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 8876 is designed for very long life and reliable performance in oscillator, amplifier, or modulator service. In most applications, it may be used as a direct replacement for the 7203/4CX250B, with only minor circuit retuning required.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	2.4	A
Cathode-Heater Potential, maximum	±150	V
Amplification Factor (Average):		
Grid to Screen	5	
Direct Interelectrode Capacitances (grounded cathode)[2]		
Cin	17.0	pF
Cout	4.5	pF
Cgp	0.04	pF
Direct Interelectrode Capacitances (grounded grid and screen)[2]		
Cin	13.6	pF
Cout	4.5	pF
Cpk	0.01	pF
Frequency of Maximum Rating:		
CW	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.46 in; 62.5 mm
Diameter	1.64 in; 41.7 mm
Net Weight	4 oz; 113 gm
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C

(Effective 6-15-71) © 1971 Varian Printed in U.S.A.

Cooling	Forced Air
Base	Special 9-pin JEDEC-B8-236
Recommended Socket	EIMAC SK-600 Series
Recommended Chimney	EIMAC SK-600 Series

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN (SSB)

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	250	250	250	mAdc
Two-Tone Plate Current	190	190	190	mAdc
Single-Tone Screen Current[2]	10	8	5	mAdc
Two-Tone Screen Current[2]	2	-1	-2	mAdc
Single-Tone Grid Current[2]	0	0	0	mAdc
Peak rf Grid Voltage[2]	50	50	50	v
Plate Output Power	120	215	300	W
Resonant Load Impedance	2000	3000	4000	Ω

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB_1, Grid Driven

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Carrier Plate Current	150	150	150	mAdc
Carrier Screen Current	-3	-4	-4	mAdc
Peak rf Grid Voltage[2]	25	25	25	v
Plate Output Power	30	50	65	W

1. Adjust to specified zero-signal dc plate current.
2. Approximate value

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)					500 MHz
Plate Voltage	500	1000	1500	2000	2000 Vdc
Screen Voltage	250	250	250	250	300 Vdc
Grid Voltage	-90	-90	-90	-90	-90 Vdc
Plate Current	250	250	250	250	250 mAdc
Screen Current[1]	45	38	21	19	10 mAdc2
Grid Current[1]	35	31	28	26	25 mAdc2
Peak rf Grid Voltage[1]	114	114	112	112	--- v
Measured Driving Power[1]	4.0	3.5	3.2	2.9	--- W
Plate Input Power	125	250	375	500	500 W
Plate Output Power	70	190	280	390	300 W[2]
Heater Voltage	6.0	6.0	6.0	6.0	5.7 V

1. Approximate value.
2. Measured values for a typical cavity amplifier circuit.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE	1500	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION[1]	165	WATTS
SCREEN DISSIPATION[2]	12	WATTS
GRID DISSIPATION[2]	2	WATTS

TYPICAL OPERATION (Frequencies to 175 MHz)

Plate Voltage	500	1000	1500	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-100	-100	-100	Vdc
Plate Current	200	200	200	mAdc
Screen Current[3]	31	22	20	mAdc
Grid Current[3]	15	14	14	mAdc
Peak rf Grid Voltage[3]	118	117	117	v
Calculated Driving Power	1.8	1.7	1.7	W
Plate Input Power	100	200	235	W

1. Corresponds to 250 watts at 100% sine-wave modulation.
2. Average, with or without modulation.
3. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB , Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate value

TYPICAL OPERATION (Two Tubes)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1/3]	-55	-55	-55	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max Signal Plate Current	500	500	500	mAdc
Max Signal Screen Current[1]	20	16	10	mAdc
Max Signal Grid Current[1]	0	0	0	mAdc
Peak af Grid Voltage[2]	50	50	50	v
Peak Driving Power	0	0	0	W
Plate Input Power	500	750	1000	W
Plate Output Power	240	430	600	W
Load Resistance (plate to plate)	3500	6200	9500	Ω

2. Per tube.
3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.		Max.	
Heater: Current at 6.0 volts	2.2	---	2.7	A
Cathode Warmup Time	60	---	---	sec.
Interelectrode Capacitances[1] (grounded cathode connection)				
Cin	15.0	---	18.0	pF
Cout	4.0	---	5.0	pF
Cgp	---	---	0.06	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 8876 may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the EIMAC SK-600 series and an EIMAC SK-606 chimney are used with air flow in the base to anode direction.

SEA LEVEL			10,000 FEET	
Plate Dissipation(watts)	Air Flow (CFM)	Pressure Drop(In.of water)	Air Flow (CFM)	Pressure Drop(In.of water)
200	5.0	0.52	7.3	0.76
250	6.4	0.82	9.3	1.20

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 MHz or below, base cooling air requirements are satisfied automatically when the tube is operated in an EIMAC Air-System Socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

VIBRATION - This tube is designed to provide reliable service under ordinary shock and vibration conditions, such as encountered in mobile installations. However, when severe shock, or high-level and high-frequency vibration are expected, it is suggested that the EIMAC 4CX300A or 4CX250R be employed.

ELECTRICAL

HEATER - The rated heater voltage for the 8876 is 6.0 volts and the voltage must be maintained within ±5% to obtain good tube life and stable performance. Regulation to a tolerance better than ±5% normally will be beneficial as regards life expectancy.

At frequencies above approximately 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the table below;

300 MHz or lower	6.00 volts
301 to 400 MHz	5.85 volts
401 to 500 MHz	5.70 volts

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 mA for plate-modulated operation and 250 mA for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 60 seconds before other operating voltages are applied. If faster warmup is required, an over-voltage of 8.0 volts may be applied to the heater and held for 30 seconds, at which time the voltage must be reduced to the rated value. Full operating cathode temperature is reached in 30 seconds with this technique. From a cold start, it is imperative that the over-voltage be held not over 30 seconds, and if the tube has not completely cooled since previous use, a shorter period of over-voltage must be used.

Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving power requirements for amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approximately 15 mA.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result 100% modulation for plate-modulated rf amplifiers using the 8876.

PLATE OPERATION - The maximum rated plate dissipation power is 250 watts. In plate-modulated applications the carrier plate dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube (s) in the event that one tube fails.

VHF OPERATION - The 8876 is suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

HIGH VOLTAGE - Normal operating voltages used with the 8876 are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

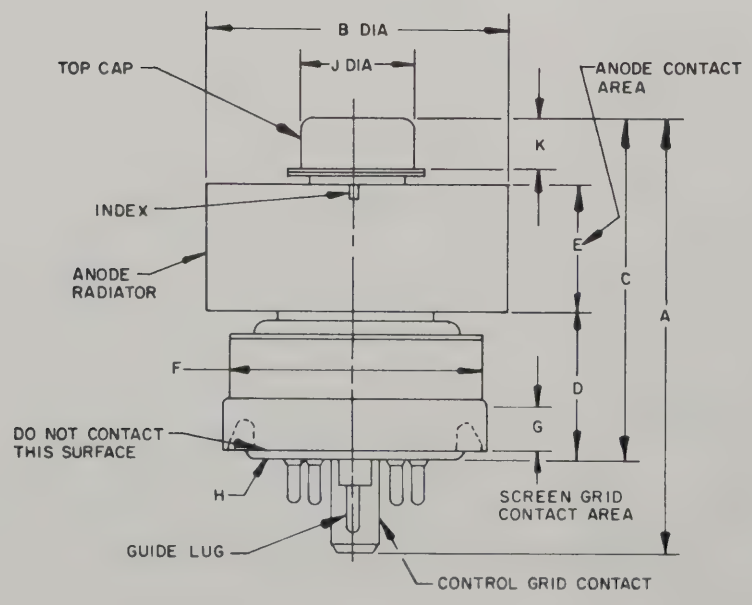
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

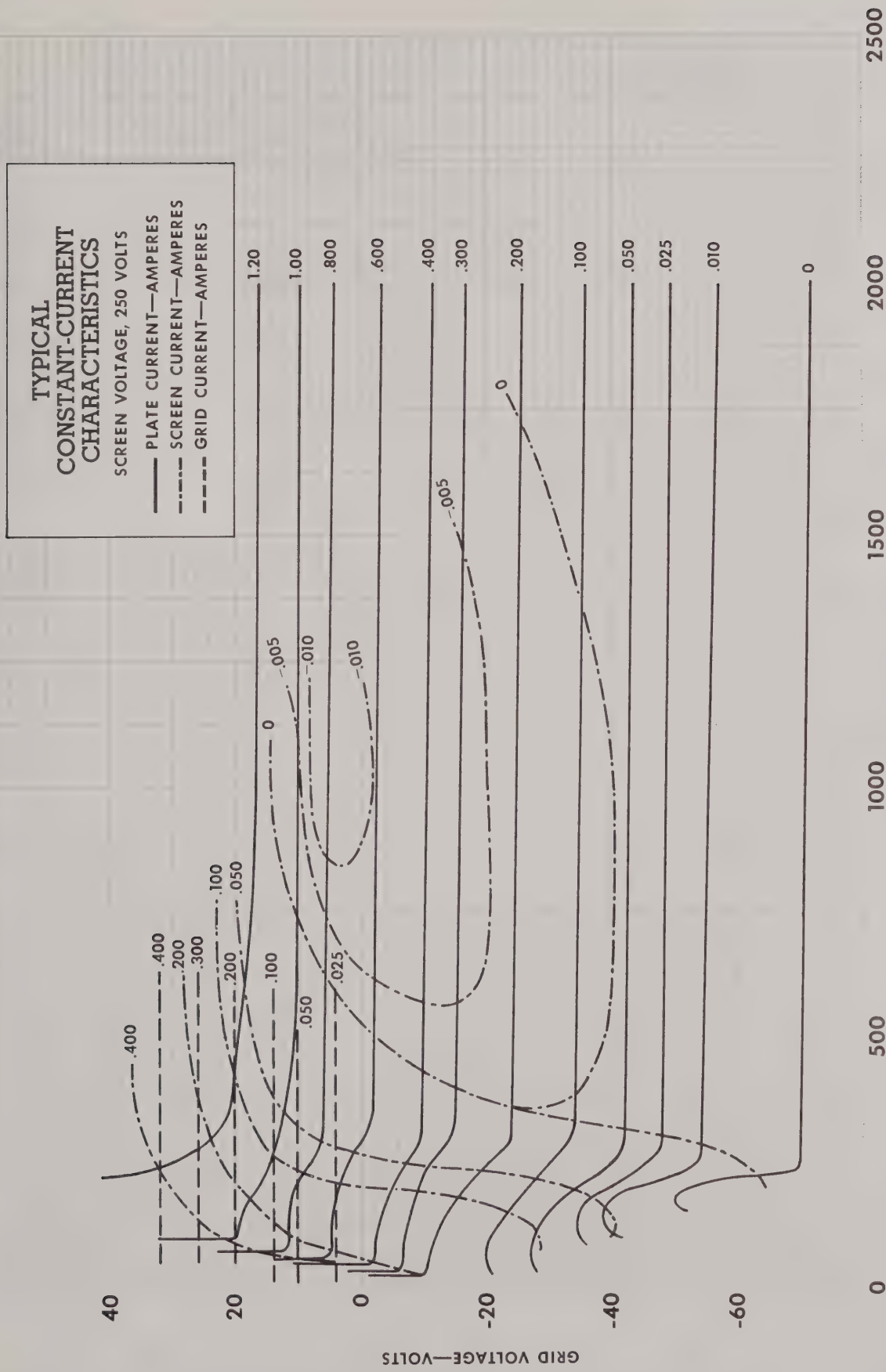
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

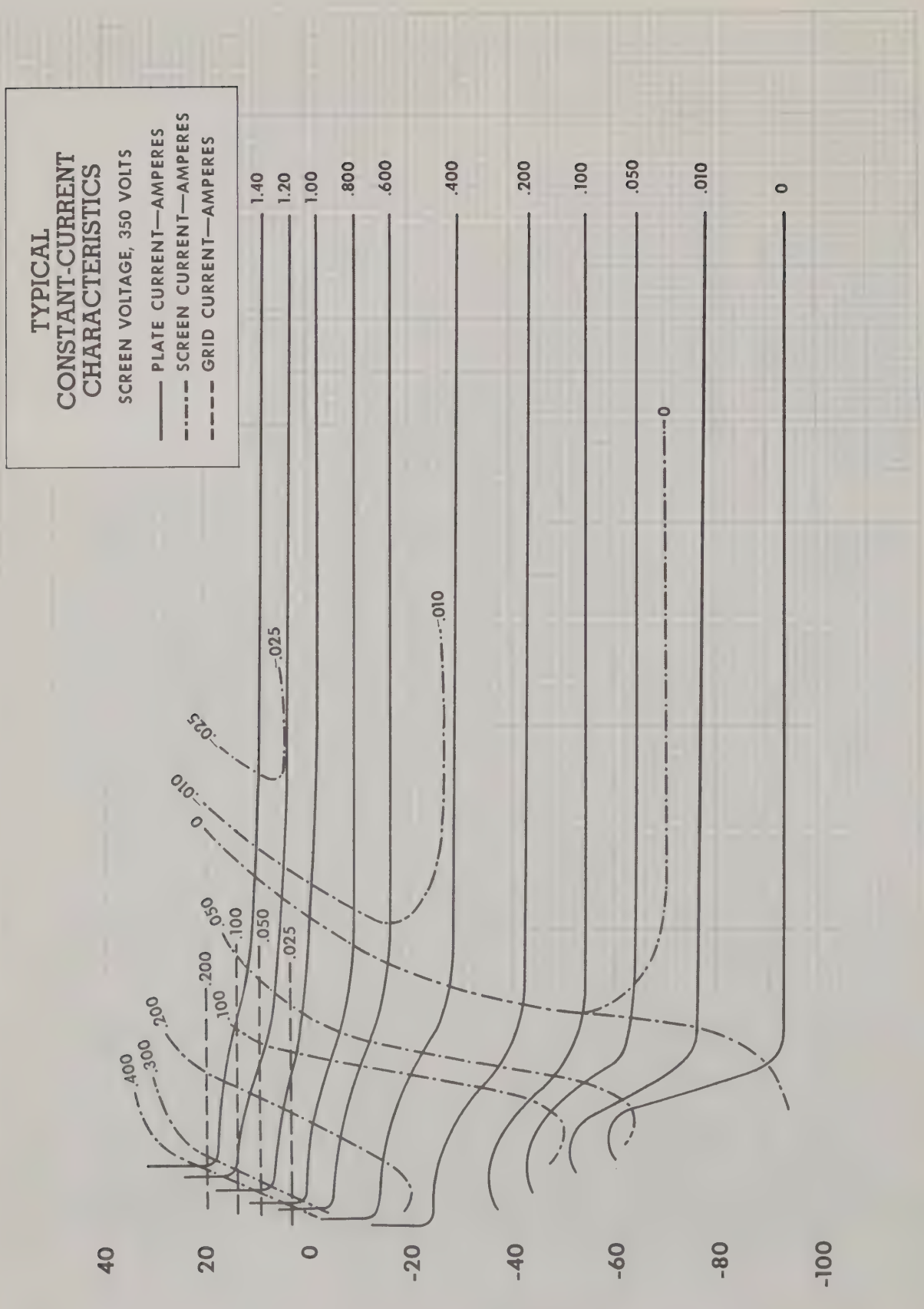
SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

PIN DESIGNATION	
PIN NO. 1	SCREEN GRID
PIN NO. 2	CATHODE
PIN NO. 3	HEATER
PIN NO. 4	CATHODE
PIN NO. 5	I.C. DO NOT USE FOR EXTERNAL CONNECTION.
PIN NO. 6	CATHODE
PIN NO. 7	HEATER
PIN NO. 8	CATHODE
CENTER PIN-CONTROL GRID	

DIMENSIONAL DATA				
DIM	INCHES		MILLIMETERS	
	MIN	MAX.	MIN.	MAX
A	2.342	2.464	59.03	62.59
B	1.610	1.640	40.89	41.66
C	1.810	1.910	45.97	48.51
D	0.750	0.810	19.05	20.57
E	0.710	0.790	18.03	20.07
F	--	1.406	--	35.71
G	0.187	--	4.75	--
H	BASE B8-236 (JEDEC DESIGNATION)			
J	0.559	0.573	14.20	14.55
K	0.240	--	6.10	--




TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
.010
.025
.050
.100
.200
.300
.400
.400
.200
.100
.050
.005
0
40
20
0
-20
-40
-60
GRID VOLTAGE—VOLTS
0
500
1000
1500
2000
2500
PLATE VOLTAGE—VOLTS


TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.025
.010
0
-.025
-.010
-0
-.050
-.100
-.200
-.300
-.400
40
20
0
-20
-40
-60
-80
-100
GRID VOLTAGE—VOLTS
0
400
800
1200
1600
2000
PLATE VOLTAGE—VOLTS

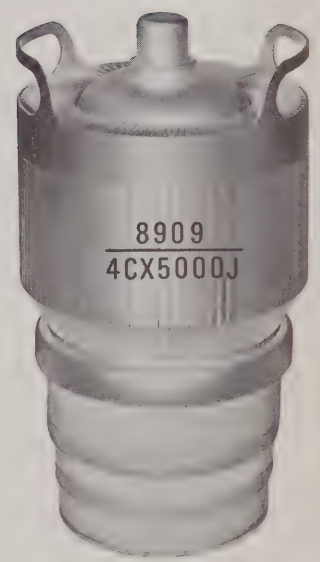
TECHNICAL DATA

8909
4CX5000J

RADIAL-BEAM
POWER TETRODE

The EIMAC 8909/4CX5000J is a compact, high-power, ceramic/metal, forced-air cooled tetrode with a rated maximum plate dissipation of 6000 watts. It incorporates rugged internal construction features, including a mesh filament/cathode.

The 8909/4CX5000J is specifically designed for exceptionally low intermodulation distortion in radio-frequency linear amplifier service.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	7.5 ± 0.37	V
Current, at 7.5 volts	103	A
Amplification Factor (Average):		
Grid to Screen	4.5	
Direct Interelectrode Capacitance (grounded filament)[2]		
Cin	120	pF
Cout	20.5	pF
Cgp	0.7	pF
Direct Interelectrode Capacitance (grounded grid)[2]		
Cin	56	pF
Cout	21.5	pF
Cpk	0.10	pF
Frequency of Maximum Rating:		
CW	100	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	
Length	9.125 in; 231.77 mm
Diameter	4.938 in; 125.43 mm
Net Weight	9.5 lb; 4.31 kg
Operating Position	Axis vertical, base up or down

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Maximum Operating Temperature:	
Ceramic/Metal Seals or Anode Core	250°C
Cooling	Forced Air
Base	Special concentric
Recommended Air System Socket	SK-300 or SK-300A
Recommended (Air) Chimney	SK-306

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN
Class AB_1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7500	VOLTS
DC SCREEN VOLTAGE	1500	VOLTS
DC PLATE CURRENT	4.0	AMPERES
PLATE DISSIPATION	6000	WATTS
SCREEN DISSIPATION	250	WATTS
GRID DISSIPATION	75	WATTS

1. Adjust to specified zero-signal dc plate current.
2. Approximate value.
3. Useful power is that delivered to the load.
4. Referenced against one tone of a two equal-tone signal.

TYPICAL OPERATION (Frequencies to 100 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	4050	Vdc
Screen Voltage	800	Vdc
Grid Voltage [1]	-155	Vdc
Zero-Signal Plate Current	750	mAdc
Single-Tone Plate Current	1.65	Adc
Single-Tone Screen Current [2]	67	mAdc
Peak rf Grid Voltage [2]	140	v
Single-Tone Plate Dissipation	3300	W
Useful Power Output (PEP) [3]	3150	W
Load Impedance	1350	Ω
Intermod. Distortion Products [4]:		
3rd Order	-41	dB
5th Order	-44	dB

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in screen current. The screen current which results when the desired plate current is obtained is incidental and varies from tube to tube. This current variation causes no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament: Current at 7.5 volts	98	108	A
Interelectrode Capacitances [1] (grounded filament connection)			
Cin	113	127	pF
Cout	18	23	pF
Cgp	---	1.0	pF
Interelectrode Capacitances [1] (grounded grid connection)			
Cin	51	61	pF
Cout	19	24	pF
Cpk	---	0.16	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

APPLICATION

MECHANICAL

MOUNTING - The 4CX5000J must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5000J. The use of recommended air-flow rates through this socket

provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

COOLING - The maximum temperature rating for the external surfaces of the 4CX5000J is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Sea level airflow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

	SK-300A Socket		SK-300 Socket	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop(Inches of water)	Air Flow (CFM)	Pressure Drop(Inches of water)
2000	75	0.4	75	0.4
3000	105	0.7	100	0.7
4000	145	1.1	135	1.2
5000	190	1.5	165	1.8
6000	230	2.0	200	2.5

Since the power dissipated by the filament represents about 770 watts and since grid-plus screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1200 watts dissipation.

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

IMPACT AND VIBRATION - The 4CX5000J is designed to operate under shock and vibration conditions which might disable a less rugged tube. Production tubes are subjected to testing to insure ability to withstand 15 G impact at 11 milliseconds duration and 2 G vibratory acceleration over the range of 5 to 55 Hz.

ELECTRICAL

FILAMENT VOLTAGE - The rated filament voltage for the 4CX5000J is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

GRID DISSIPATION - The 4CX5000J control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. Grid dissipation is approximately the product of dc grid current and peak positive grid voltage. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

SCREEN DISSIPATION - The power dissipated by the screen of the 4CX5000J must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX5000J is 6000 watts. Plate dissipation may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

HIGH VOLTAGE - The 4CX5000J operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and

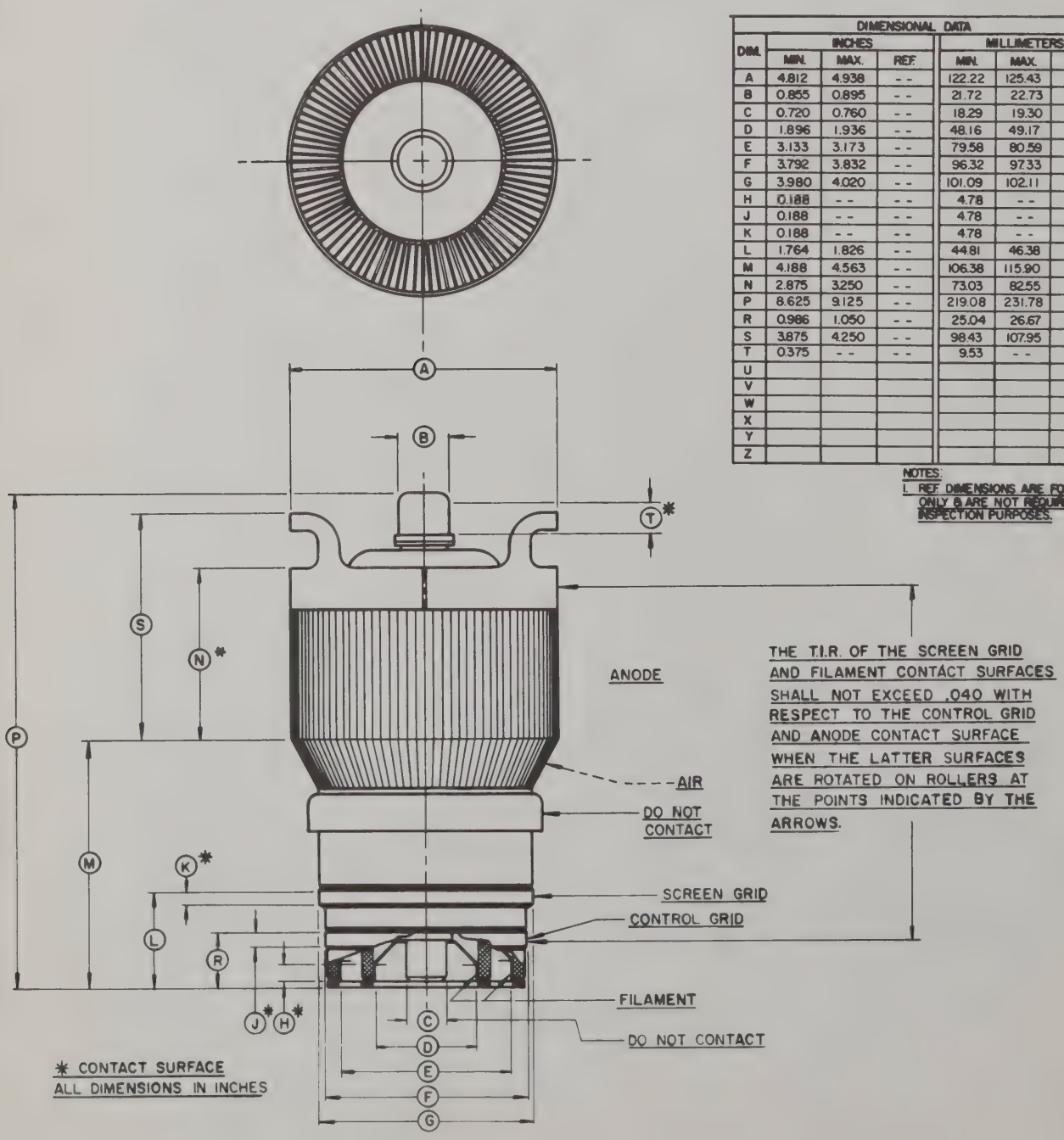
wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

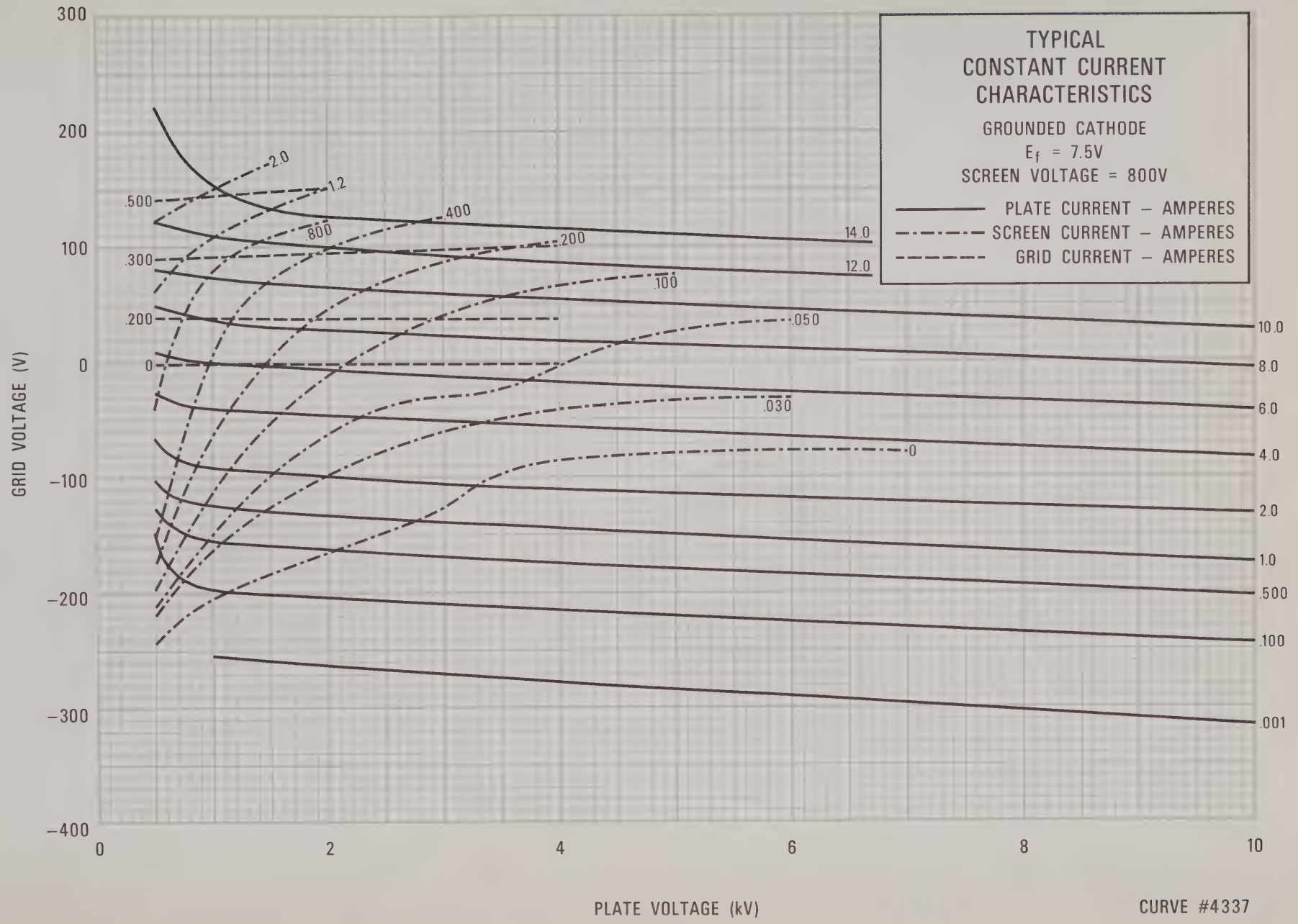
The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

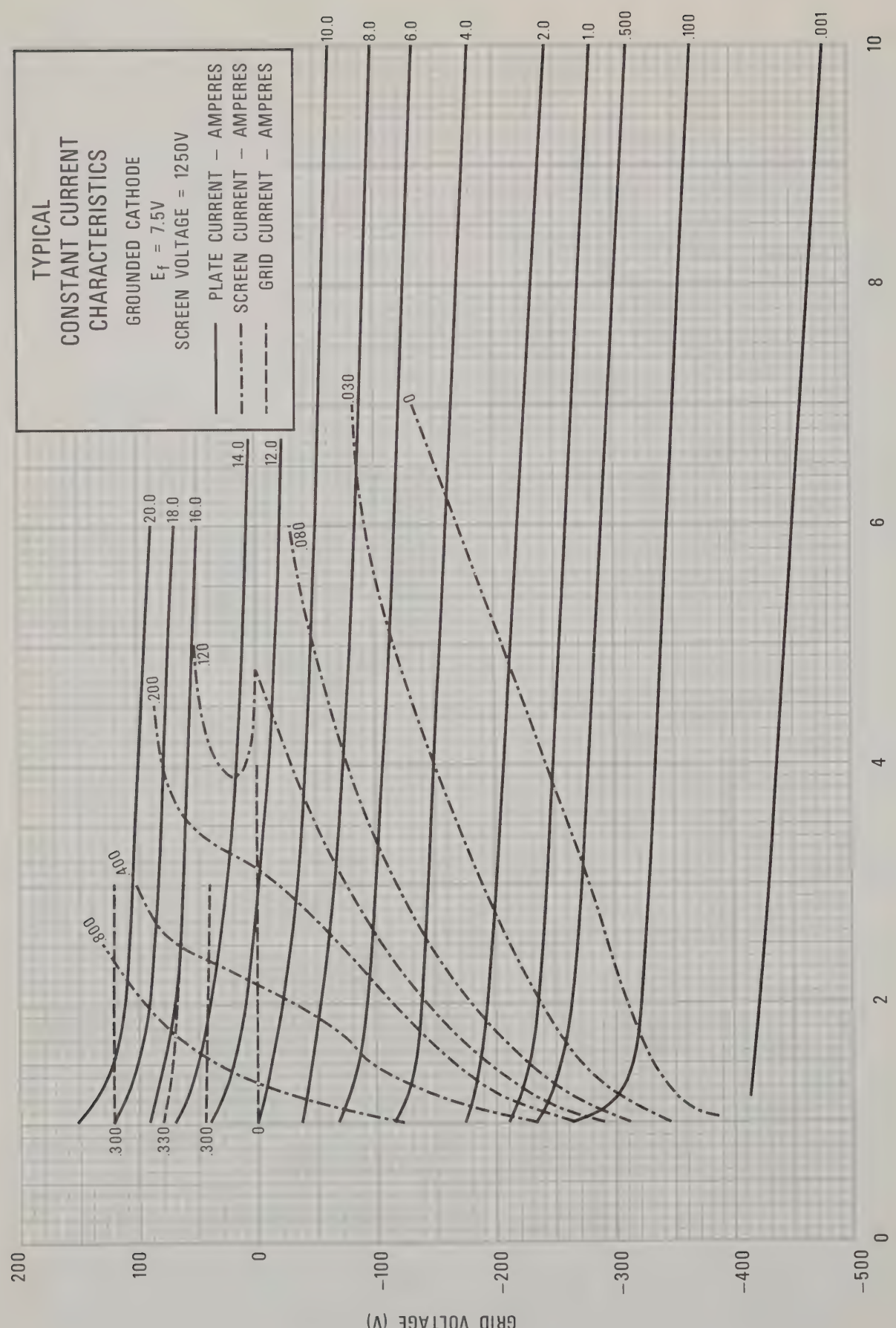
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.812	4.938	- -	122.22	125.43	- -
B	0.855	0.895	- -	21.72	22.73	- -
C	0.720	0.760	- -	18.29	19.30	- -
D	1.896	1.936	- -	48.16	49.17	- -
E	3.133	3.173	- -	79.58	80.59	- -
F	3.792	3.832	- -	96.32	97.33	- -
G	3.980	4.020	- -	101.09	102.11	- -
H	0.188	- -	- -	4.78	- -	- -
J	0.188	- -	- -	4.78	- -	- -
K	0.188	- -	- -	4.78	- -	- -
L	1.764	1.826	- -	44.81	46.38	- -
M	4.188	4.563	- -	106.38	115.90	- -
N	2.875	3.250	- -	73.03	82.55	- -
P	8.625	9.125	- -	219.08	231.78	- -
R	0.986	1.050	- -	25.04	26.67	- -
S	3.875	4.250	- -	98.43	107.95	- -
T	0.375	- -	- -	9.53	- -	- -
U						
V						
W						
X						
Y						
Z						

NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.




TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 7.5V
SCREEN VOLTAGE = 800V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
300
200
100
0
−100
−200
−300
−400
0
2
4
6
8
10
PLATE VOLTAGE (kV)
2.0
1.2
.500
.800
.400
.300
.200
.100
.050
0
.030
0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
1.0
.500
.100
.001

CURVE #4337


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 7.5V
SCREEN VOLTAGE = 1250V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
10.0
8.0
6.0
4.0
2.0
1.0
.500
.100
.001
.030
0
.080
14.0
12.0
20.0
18.0
16.0
.200
120
.400
.800
.300
.330
.300
0
200
100
0
−100
−200
−300
−400
−500
0
2
4
6
8
10
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)

CURVE #4339

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

8171
4CX10,000D
RADIAL-BEAM POWER TETRODE



The Eimac 8171/4CX10,000D is a metal-ceramic tetrode which is identical electrically to the 8170/4CX5000A except for its rated plate dissipation. Its increased dissipation capability, resulting from a larger cooler, is most useful in linear applications where plate dissipation is generally the limiting factor. Accordingly, more output power can be obtained in r-f or a-f linear service and "Typical" operating conditions have been modified to reflect this change in tube capability.

The improved cooler also allows the 8171/4CX10,000D to be used in place of the 8170/4CX5000A with less cooling for any given plate dissipation or results in cooler operation at any given air-flow rate.

The 8171/4CX10,000D is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megacycles and is particularly suited for use as a linear r-f amplifier or class-AB_1 audio amplifier.

A pair of these tubes, operating class-AB_1 will deliver more than 30 kilowatts of audio-frequency or radio-frequency plate output power.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amperes
Amplification Factor (Grid-Screen)		4.5		

Direct Interelectrode Capacitances, Grounded Cathode:

Input	108	122	uuf
Output	18	23	uuf
Feedback		1.0	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:

	Min.	Max.	
Input	48	58	uuf
Output	18	23	uuf
Feedback		0.16	uuf

MECHANICAL

Base	Special concentric
Maximum Seal Temperature	250° C
Maximum Anode-Core Temperature	250° C
Recommended Socket	Eimac SK-300A
Recommended Air Chimney	Eimac SK-1306
Operating Position	Axis vertical, base up or down

Maximum Dimensions:

Height	9.13 inches
Diameter	7.05 inches
Cooling	Forced air
Net Weight	12.2 pounds
Shipping Weight (Approximate)	23 pounds

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RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 110 megacycles)

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	up to 30 megacycles	7500 MAX.	VOLTS
	30 to 60 megacycles	7000 MAX.	VOLTS
	60 to 110 megacycles	6500 MAX.	VOLTS
D-C SCREEN VOLTAGE		1500 MAX.	VOLTS
D-C PLATE CURRENT	up to 30 megacycles	3 MAX.	AMPERES
	30 to 60 megacycles	2.8 MAX.	AMPERES
	60 to 110 megacycles	2.6 MAX.	AMPERES
PLATE DISSIPATION		10,000 MAX.	WATTS
SCREEN DISSIPATION		250 MAX.	WATTS
GRID DISSIPATION		75 MAX.	WATTS

TYPICAL OPERATION
(Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	500	volts
D-C Grid Voltage	—350	volts
D-C Plate Current	2.8	amperes
D-C Screen Current	0.5	ampere
D-C Grid Current	0.25	ampere
Peak R-F Grid Voltage	590	volts
Driving Power	150	watts
Plate Dissipation	5000	watts
Plate Output Power	16,000	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX.	VOLTS
D-C SCREEN VOLTAGE	1000 MAX.	VOLTS
D-C PLATE CURRENT	2.5 MAX.	AMPERES
PLATE DISSIPATION*	6650 MAX.	WATTS
SCREEN DISSIPATION	250 MAX.	WATTS
GRID DISSIPATION	75 MAX.	WATTS

*Corresponds to 10,000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megacycles)

D-C Plate Voltage	5000	volts
D-C Screen Voltage	500	volts
Peak A-F Screen Voltage (For 100-percent modulation)	450	Volts
D-C Grid Voltage	—400	volts
D-C Plate Current	1.4	amperes
D-C Screen Current	0.26	ampere
D-C Grid Current	0.05	ampere
Peak R-F Grid Voltage	520	volts
Grid Driving Power	25	watts
Plate Dissipation	1100	watts
Plate Output Power	5.8	kilowatts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX.	VOLTS
D-C SCREEN VOLTAGE	1500 MAX.	VOLTS
D-C PLATE CURRENT	4.0 MAX.	AMPERES
PLATE DISSIPATION	12,000 MAX.	WATTS
SCREEN DISSIPATION	250 MAX.	WATTS
GRID DISSIPATION	75 MAX.	WATTS

TYPICAL OPERATION, two tubes

D-C Plate Voltage	4000	5000	6000	7500	volts
D-C Screen Voltage	1500	1500	1500	1500	volts
D-C Grid Voltage	—315	—320	—330	—340	volts
Max.-Signal Plate Current	6.66	6.66	6.66	6.66	ampere
Zero-Signal Plate Current*	0.50	0.50	0.50	0.50	ampere
Max.-Signal Screen Current	0.33	0.32	0.30	0.25	ampere
Zero-Signal Screen Current	0	0	0	0	ampere
Peak A-F Driving Voltage	305	310	320	330	volts
Driving Power	0	0	0	0	watts
Load Resistance, Plate-to-Plate	940	1320	1700	2280	ohms
Max.-Signal Plate Dissipation	6,670	7,950	8,100	9,050	watts
Max.-Signal Plate Output Power	13,300	17,500	23,800	31,900	watts

*Per Tube

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX.	VOLTS
D-C SCREEN VOLTAGE	1500 MAX.	VOLTS
D-C PLATE CURRENT	4.0 MAX.	AMPERES
PLATE DISSIPATION	12,000 MAX.	WATTS
SCREEN DISSIPATION	250 MAX.	WATTS
GRID DISSIPATION	75 MAX.	WATTS

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions,
(Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	1500	volts
D-C Grid Voltage*	—340	volts
Max.-Signal Plate Current	3.33	amperes
Zero-Signal Plate Current	0.50	ampere
Max.-Signal Screen Current	.125	ampere
Peak R-F Grid Voltage	330	volts
Driving Power	0	watts
Plate Dissipation	9050	watts
Plate Output Power**	15,950	watts

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or r-f output power at crest of modulation envelope.

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MECHANICAL

Mounting—The 4CX10000D must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—A new, more efficient Eimac Air-System Socket Type SK-300A has been designed especially for the concentric base terminals of the 4CX10000D. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-1306, into the anode cooling fins.

Cooling—The maximum temperature rating for the external surfaces of the 4CX10000D is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

	SEA LEVEL		10,000 FEET	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
4000	110	0.4	160	0.6
6000	200	0.8	290	1.2
8000	315	1.7	460	2.5
10000	445	2.8	645	4.1
12000	600	4.4	870	6.4

*Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX10000D is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus 5 percent from the rated value.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4CX10000D must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

Control-Grid Operation— The 4CX10000D control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

Screen-Grid Operation—The power dissipated by the screen of the 4CX10000D must not exceed 250 watts.

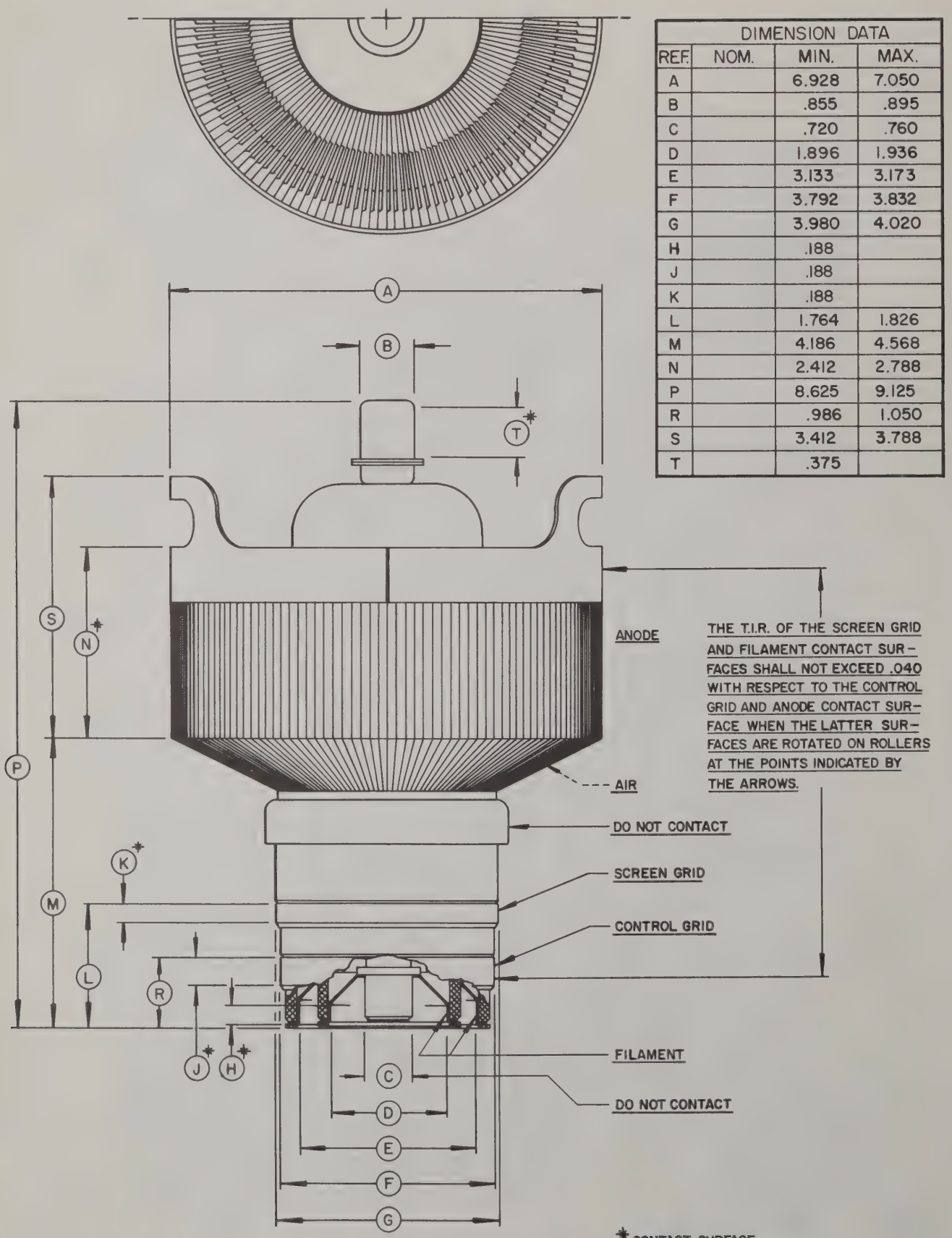
Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

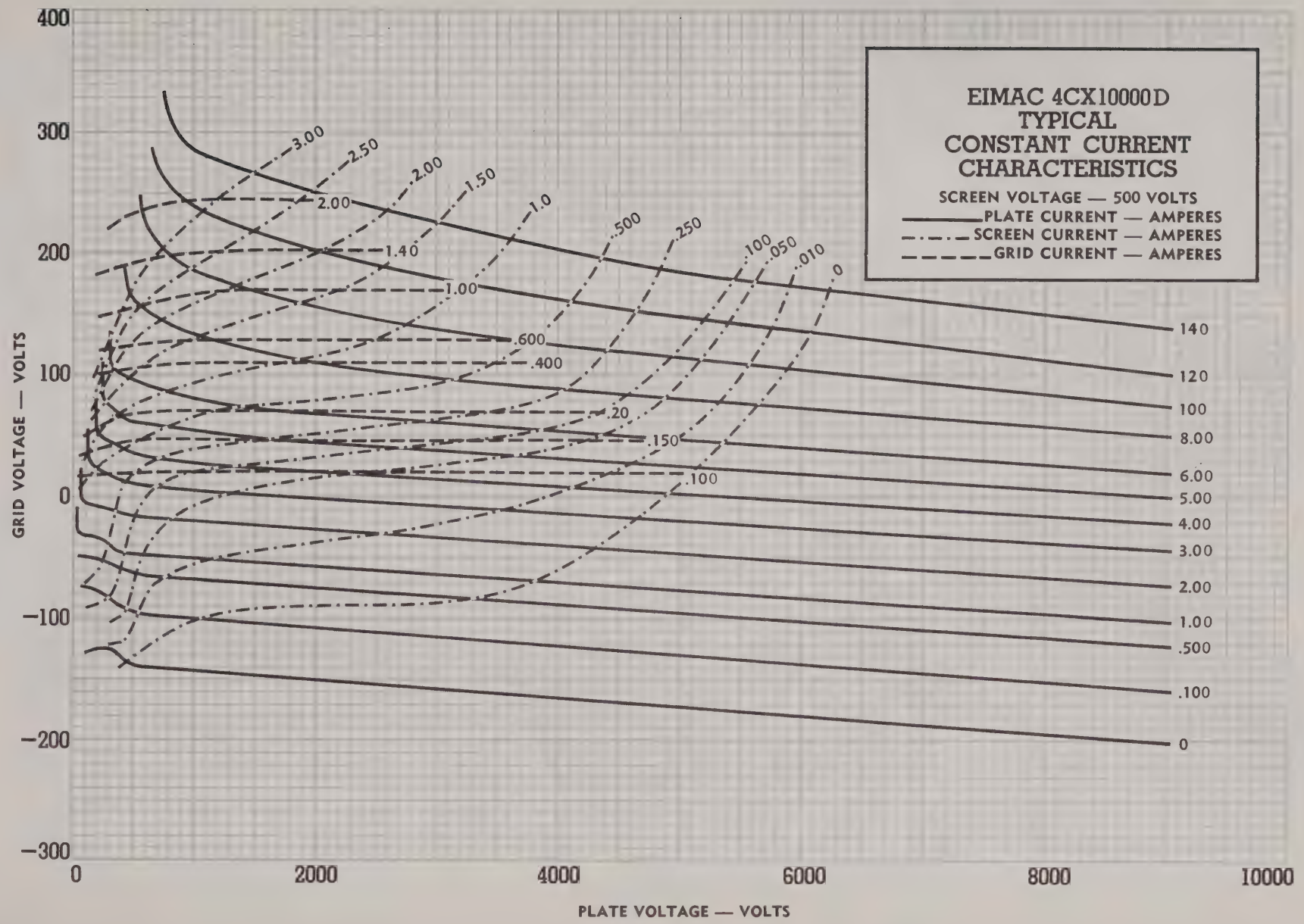
Plate Dissipation—The plate-dissipation rating for the 4CX10000D is 10,000 watts for most applications, but for audio and SSB amplifier applications, the maximum allowable dissipation is 12,000 watts.

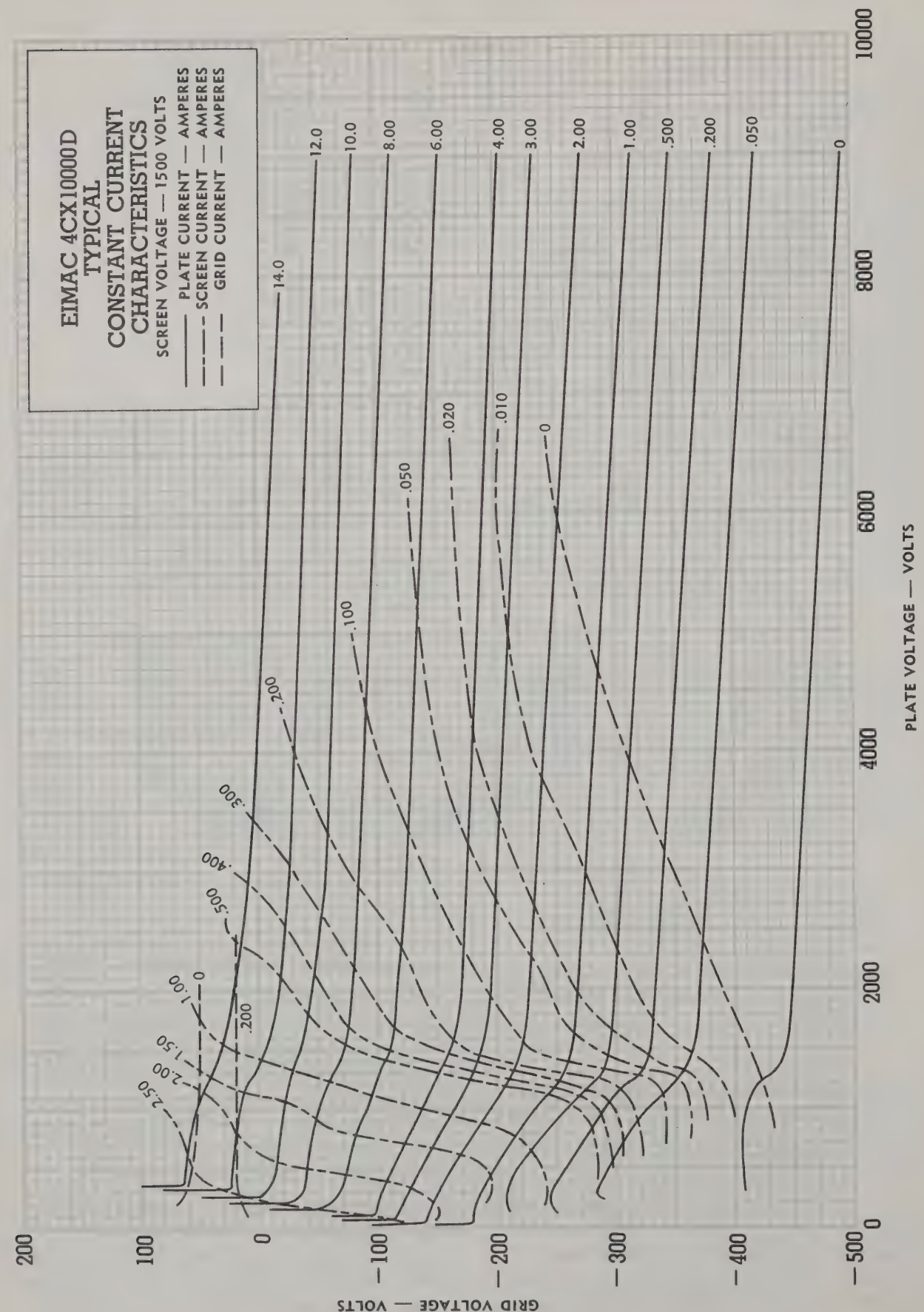
When the 4CX10000D is operated as a plate-modulated r-f power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 6650-watt maximum plate dissipation rating will be exceeded.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A		6.928	7.050
B		.855	.895
C		.720	.760
D		1.896	1.936
E		3.133	3.173
F		3.792	3.832
G		3.980	4.020
H		.188	
J		.188	
K		.188	
L		1.764	1.826
M		4.186	4.568
N		2.412	2.788
P		8.625	9.125
R		.986	1.050
S		3.412	3.788
T		.375	


EIMAC 4CX10000D
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
3.00
2.50
2.00
1.50
1.0
.500
.250
.100
.050
.010
0
2.00
1.40
1.00
.600
.400
.20
.150
.100
140
120
100
8.00
6.00
5.00
4.00
3.00
2.00
1.00
.500
.100
0



Printed in U.S.A. 973

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

TENTATIVE DATA

8281
4CX15,000A

RADIAL-BEAM POWER TETRODE



The Eimac 8281/4CX15.000A is a ceramic-metal power tetrode intended for use as a Class-C amplifier in radio-frequency applications. It features a new type of internal mechanical structure which results in higher rf operating efficiency. Low rf losses in this mechanical structure permit operation of the 8281/4CX15.000A at full ratings up to 110 megacycles.

The 8281/4CX15,000A is also recommended for Class-AB audio-frequency and radio-frequency linear power amplifier service.

GENERAL CHARACTERISTICS

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		6.3		volts
Current	152		168	amps
Amplification Factor (Grid-Screen) (average)		4.5		

Direct Interelectrode Capacitances, Grounded Cathode:	Min.	Max.	
Input	158	172	uuf
Output	22.0	27.0	uuf
Feedback		2.0	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:			
Input	63.0	78.0	uuf
Output	23.0	28.0	uuf
Feedback		0.3	uuf

Base	Special, concentric
Maximum Seal Temperature	250°C
Maximum Anode Core Temperature	250°C
Recommended Socket	Eimac SK-300A
Recommended Air Chimney	Eimac SK-316
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	9.44 inches
Diameter	7.58 inches
Cooling	Forced air
Net Weight	12.8 pounds
Shipping Weight (Approximate)	24 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS			
DC PLATE VOLTAGE	10,000	MAX.	VOLTS
DC SCREEN VOLTAGE	2,000	MAX.	VOLTS
DC PLATE CURRENT	5.0	MAX.	AMPS
PLATE DISSIPATION	15,000	MAX.	WATTS
SCREEN DISSIPATION	450	MAX.	WATTS
GRID DISSIPATION	200	MAX.	WATTS

TYPICAL OPERATION

DC Plate Voltage	7,500	10,000	volts
DC Screen Voltage	750	750	volts
DC Grid Voltage	-510	-550	volts
DC Plate Current	4.65	4.55	amps
DC Screen Current	.595	.545	amp
DC Grid Current	.300	.275	amp
Peak RF Grid Voltage	730	790	volts
Driving Power	220	220	watts
Plate Dissipation	8,100	9,000	watts
Plate Output Power	26,700	36,500	watts

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PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier Conditions unless noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	8.000 MAX.	VOLTS
DC SCREEN VOLTAGE	1.500 MAX.	VOLTS
DC PLATE CURRENT	4.0 MAX.	AMPS
PLATE DISSIPATION*	10.000 MAX.	WATTS
SCREEN DISSIPATION	450 MAX.	WATTS
GRID DISSIPATION	200 MAX.	WATTS

*Corresponds to 15.000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION

DC Plate Voltage	6.000	8.000 volts
DC Screen Voltage	750	750 volts
Peak AF Screen Voltage (For 100% modulation)	740	710 volts
DC Grid Voltage	-600	-640 volts
DC Plate Current	3.75	3.65 amps
DC Screen Current	.450	.430 amp
DC Grid Current	.185	.180 amp
Peak RF Grid Voltagee	800	840 volts
Grid Driving Power	150	150 watts
Plate Dissipation	5.100	5.800 watts
Plate Output Power	17.400	23.500 watts

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	10.000 MAX.	VOLTS
DC SCREEN VOLTAGE	2.000 MAX.	VOLTS
DC PLATE CURRENT	6.0 MAX.	AMPS
PLATE DISSIPATION	15.000 MAX.	WATTS
SCREEN DISSIPATION	450 MAX.	WATTS
GRID DISSIPATION	200 MAX.	WATTS

*Per Tube
** Approximate Values

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	7.500	10.000 volts
DC Screen Voltage	1,500	1.500 volts
DC Grid Voltage	-350	-370 volts
Max-Signal Plate Current	8.8	8.5 amps
Zero-Signal Plate Current*	1.0	1.0 amp
Max-Signal Screen Current**	.340	.300 amp
Zero-Signal Screen Current	0	0 amps
Peak AF Driving Voltage*	330	340 volts
Driving Power	0	0 watts
Load Resistance, Plate-to-Plate	1,730	2,520 ohms
Max-Signal Plate Dissipation*	12,200	14,000 watts
Max-Signal Plate Output Power	41,600	57,000 watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	10,000 MAX.	VOLTS
DC SCREEN VOLTAGE	2,000 MAX.	VOLTS
DC PLATE CURRENT	6.0 MAX.	AMPS
PLATE DISSIPATION	15,000 MAX.	WATTS
SCREEN DISSIPATION	450 MAX.	WATTS
GRID DISSIPATION	200 MAX.	WATTS

*Approximate Values

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions,

DC Plate Voltage	7,500	10.000 volts
DC Screen Voltage	1,500	1,500 volts
DC Grid Voltage	-350	-370 volts
Max-Signal Plate Current	4.4	4.25 amps
Zero-Signal Plate Current	1.0	1.0 amp
Max-Signal Screen Current*	.170	.150 amp
Peak RF Grid Voltage*	330	340 volts
Driving Power	0	0 watts
Plate Dissipation	12,200	14,000 watts
Plate Output Power	20,800	28,500 watts
Resonant Load Impedance	865	1,260 ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

Mounting— The 4CX15,000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket— A new, more efficient Eimac Air-System Socket Type SK-300A has been designed especially for the concentric base terminals of the 4CX15,000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-316, into the anode cooling fins.

Cooling— The maximum temperature rating for the external surfaces of the 4CX15,000A is 250° C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250° C. Air-flow requirements to maintain seal temperatures at 225° C. in 50° C ambient air are tabulated below (for operation below 30 megacycles).

	SEA LEVEL		10,000 FEET	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
7,500	240	0.75	355	1.1
12,000	530	2.8	775	4.1
15,000	765	5.1	1115	7.5

*Since the power dissipated by the filament represents about 1000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 600 watts, allowance has been made in preparing this tabulation for an additional 1600 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation— The rated filament voltage for the 4CX15,000A is 6.3 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

Electrode Dissipation Ratings— The maximum dissipation ratings for the 4CX15,000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

Control-Grid Operation— The 4CX15,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation— The power dissipated by the screen of the 4CX15,000A must not exceed 450 watts.

Screen dissipation, in cases where there is no a-c applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 450 watts in the event of circuit failure.

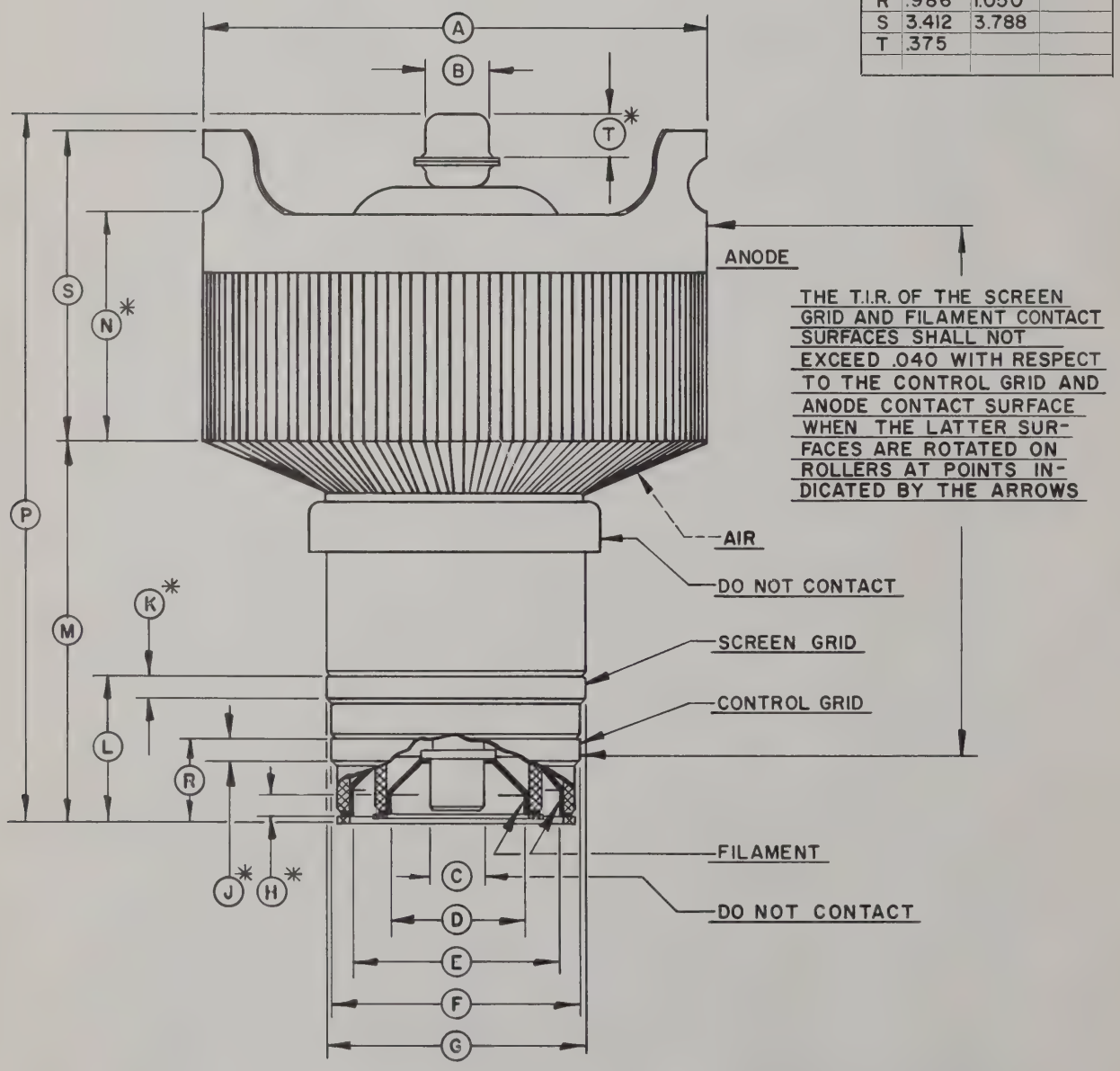
Plate Dissipation— The plate-dissipation rating for the 4CX15,000A is 15,000 watts.

When the 4CX15,000A is operated as a plate-modulated r-f power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 10,000-watt maximum plate dissipation rating will be exceeded.

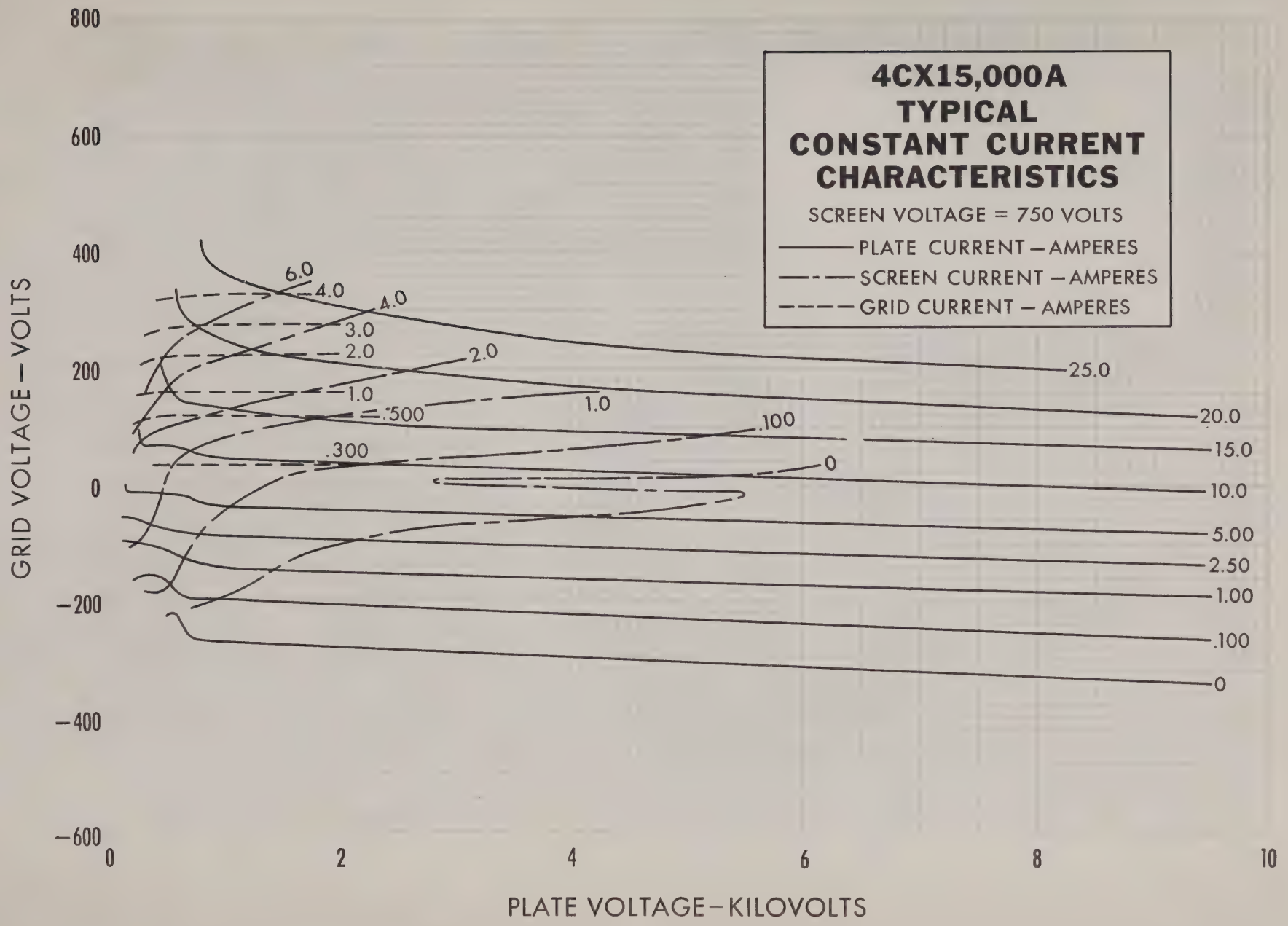
Special Applications— If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California, for information and recommendations.

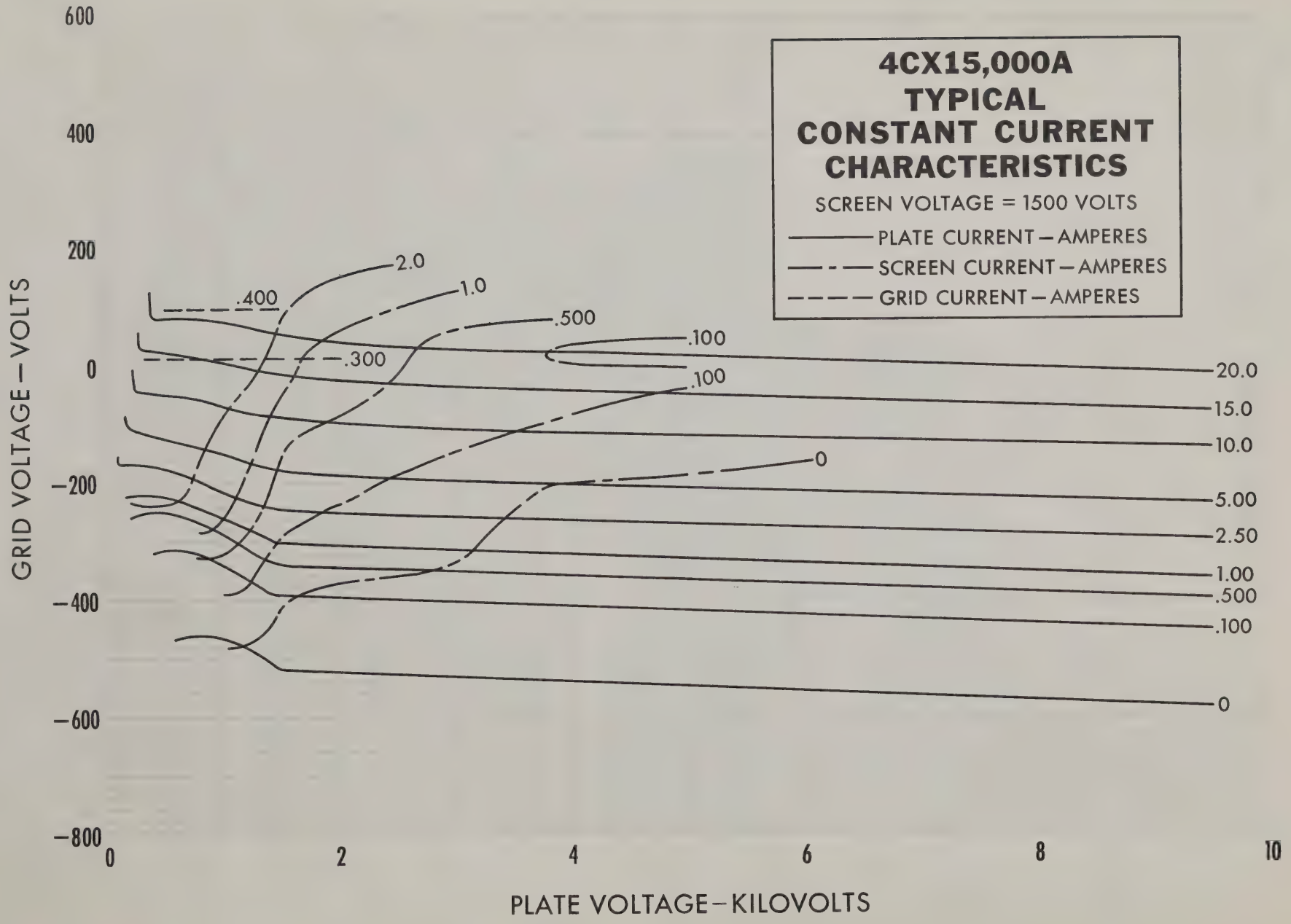
DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	7.460	7.580	
B	.855	.895	
C	.720	.760	
D	1.896	1.936	
E	3.133	3.173	
F	3.792	3.832	
G	3.980	4.020	
H	.188		
J	.188		
K	.188		
L	1.764	1.826	
M	4.500	4.875	
N	2.412	2.788	
P	8.940	9.440	
R	.986	1.050	
S	3.412	3.788	
T	.375		



* CONTACT SURFACE


4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
800
600
400
200
0
–200
–400
–600
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
6.0
4.0
4.0
3.0
2.0
2.0
1.0
1.0
.500
.100
.300
0
25.0
20.0
15.0
10.0
5.00
2.50
1.00
.100
0

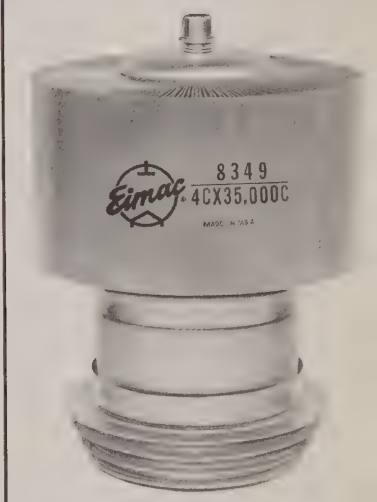

4CX15,000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
600
400
200
0
–200
–400
–600
–800
GRID VOLTAGE – VOLTS
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
2.0
1.0
.400
.300
.500
.100
.100
0
20.0
15.0
10.0
5.00
2.50
1.00
.500
.100
0

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

TENTATIVE DATA

8349
4CX35,000C

RADIAL BEAM POWER TETRODE



The Eimac 8349/4CX35,000C is a ceramic-metal, forced-air cooled power tetrode intended for use at the 50 to 150 kilowatt output power level. It is recommended for use as a Class-C rf amplifier or oscillator, a Class-AB, rf linear amplifier or a Class-AB, push-pull af amplifier or modulator. The 8349/4CX35,000C is also useful as a plate and screen modulated Class-C rf amplifier.

The forced air cooled anode is rated at 35 kilowatts of plate dissipation.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament:	Thoriated Tungsten	
	Voltage	10 volts
	Current	300 amps
	Amplification Factor (Grid-Screen) (average)	4.5
Direct Interelectrode Capacitances, Grounded Cathode:		
	Input	430 uuf
	Output	45 uuf
	Feedback	2.3 uuf
Frequency for Maximum Ratings		30 Mc

MECHANICAL

Base	Special, graduated rings
Maximum Seal Temperature	250° C
Maximum Anode Core Temperature	250° C
Recommended Socket	Eimac, SK-1500
Operating Position	Vertical, base up or down
Maximum Dimensions:	
Height	15.0 inches
Diameter	9.75 inches
Cooling	Forced air
Net Weight	50 pounds
Shipping Weight (approximate)	80 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 30 megacycles)

DC Plate Voltage	10	15	20	kV
DC Screen Voltage	750	750	750	volts
DC Grid Voltage	-425	-480	-545	volts
DC Plate Current	6.70	6.45	6.35	amps
DC Screen Current	.925	.810	.895	amp
DC Grid Current	.320	.355	.335	amp
Peak RF Grid Voltage	575	640	695	volts
Driving Power	185	225	230	watts
Plate Dissipation	12.0	14.0	17.0	kW
Plate Output Power	55.0	82.5	110.0	kW

Note: Maximum plate voltage and plate current cannot be applied simultaneously without exceeding dissipation ratings.

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PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

DC PLATE VOLTAGE	15,000 MAX. VOLTS
DC SCREEN VOLTAGE	2000 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION*	23,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

* Corresponds to 35,000 watts at 100 percent sine-wave modulation

**Approximate value

TYPICAL OPERATION
(Frequencies below 30 megacycles)

DC Plate Voltage	7.5	10	15	kV
DC Screen Voltage	750	750	750	volts
Peak AF Screen Voltage (For 100% modulation)**	640	675	630	volts
DC Grid Voltage	-460	-520	-540	volts
DC Plate Current	7.0	6.6	6.45	amps
DC Screen Current	1.2	.985	.890	amp
DC Grid Current	.375	.370	.355	amp
Peak RF Grid Voltage	630	680	700	volts
Grid Driving Power	235	250	250	watts
Plate Dissipation	15.8	16.5	21.8	kW
Plate Output Power	42.0	55.0	82.5	kW

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

* Per Tube

**Approximate value

TYPICAL OPERATION (Two Tubes)

DC Plate Voltage	10	15	20	kV
DC Screen Voltage	1.5	1.5	1.5	kV
DC Grid Voltage	-290	-340	-360	volts
Max-Signal Plate Current	17.4	15.1	13.2	amps
Zero-Signal Plate Current	4.0	2.0	2.0	amps
Max-Signal Screen Current**	.770	.620	.580	amp
Zero-Signal Screen Current	0	0	0	amp
Peak AF Driving Voltage*	270	310	320	volts
Driving Power	0	0	0	watts
Load Resistance, Plate-to-Plate	1150	2560	3000	ohms
Max-Signal Plate Dissipation*	33	30.5	22	kW
Max-Signal Plate Output Power	110	165	220	kW

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

DC PLATE VOLTAGE	20,000 MAX. VOLTS
DC SCREEN VOLTAGE	2500 MAX. VOLTS
DC PLATE CURRENT	15.0 MAX. AMPS
PLATE DISSIPATION	35,000 MAX. WATTS
SCREEN DISSIPATION	1750 MAX. WATTS
GRID DISSIPATION	500 MAX. WATTS

*Approximate value

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions, (Frequencies below 30 megacycles)

DC Plate Voltage	10	15	20	kV
DC Screen Voltage	1.5	1.5	1.5	kV
DC Grid Voltage	-290	-340	-360	volts
Max-Signal Plate Current	8.7	7.55	6.6	amps
Zero-Signal Plate Current	2.0	1.0	1.0	amp
Max-Signal Screen Current*	.385	.310	.290	amp
Peak RF Grid Voltage	270	310	320	volts
Driving Power	0	0	0	watts
Plate Dissipation	33	30.5	22	kW
Plate Output Power	55	82.5	110	kW
Resonant Load Impedance	575	1280	1500	ohms

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf driving voltage is applied.

APPLICATION

MECHANICAL

MOUNTING — The 4CX35,000C must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET — The Eimac Socket, Type SK-1500, has been designed especially for the concentric base terminals of the 4CX35,000C. The SK-1500 is not an Air System Socket. Separate base cooling is required and is accomplished by directing 60-100 CFM of air horizontally through the socket from the side.

COOLING — The maximum temperature rating for the external surfaces of the 4CX35,000C is 250° C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250° C. Air-flow requirements to maintain seal temperatures at 225° C in 40° C ambient air are tabulated below (for operation below 30 megacycles). These data are for air flowing in the anode-to-base direction.

	SEA LEVEL		5000 FEET	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
15,000	600	1.6	720	1.95
25,000	1040	4.2	1250	5.1
35,000	1720	10	2060	12

*Since the power dissipated by the filament represents about 3000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 2250 watts, allowance has been made in preparing this tabulation for an additional 5250 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION —The rated filament voltage for the 4CX35,000C is 10.0 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

ELECTRODE DISSIPATION RATINGS — The maximum dissipation ratings for the 4CX35,000C must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

CONTROL-GRID OPERATION — The 4CX35,000C control grid has a maximum dissipation rating of 500 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

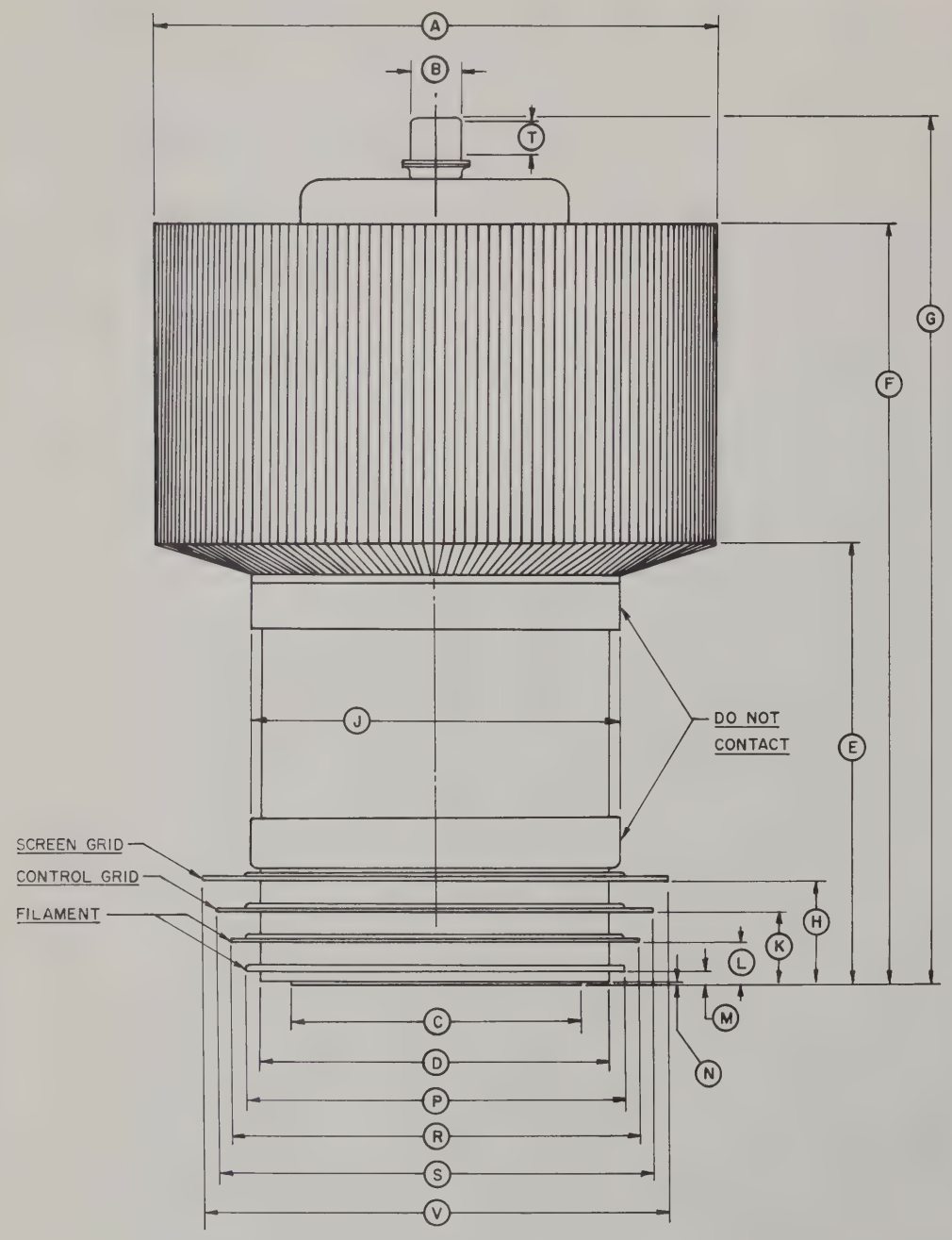
SCREEN-GRID OPERATION — The power dissipated by the screen of the 4CX35,000C must not exceed 1750 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 1750 watts in the event of circuit failure.

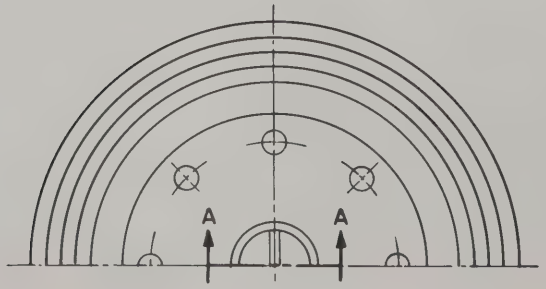
PLATE DISSIPATION — The plate-dissipation rating for the 4CX35,000C is 35,000 watts. When the 4CX35,000C is operated as a plate-modulated rf amplifier, the plate dissipation rating is reduced to 23,000 watts. In addition the plate voltage rating is reduced to 15,000 volts. Since the power input is limited by conditions other than plate efficiency, there is little possibility of exceeding the 23,000 watt dissipation rating except during tuning.

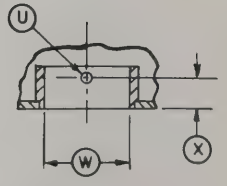
SPECIAL APPLICATIONS — If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., 301 Industrial Way, San Carlos, California for information and recommendations.



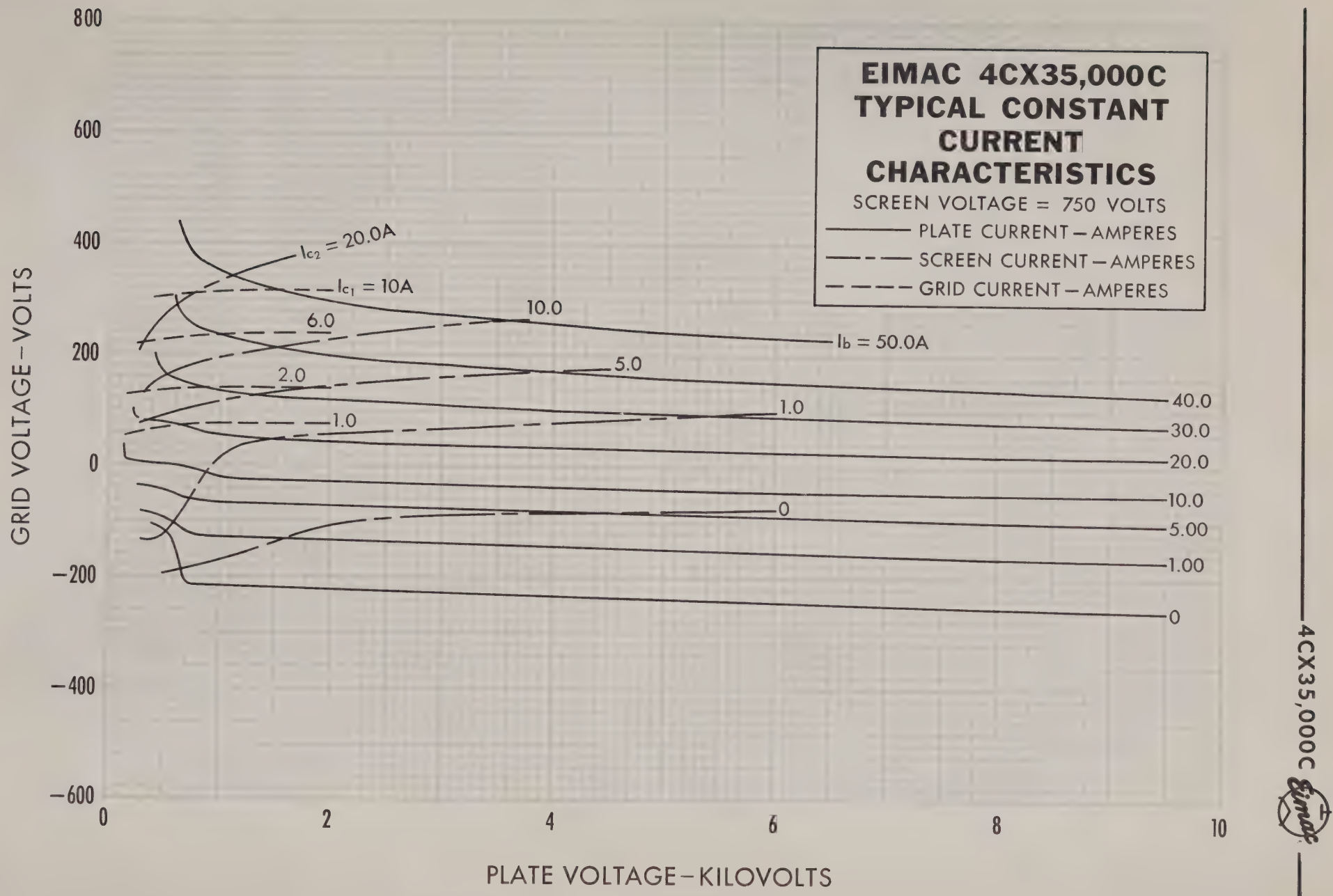
DIMENSIONS IN INCHES

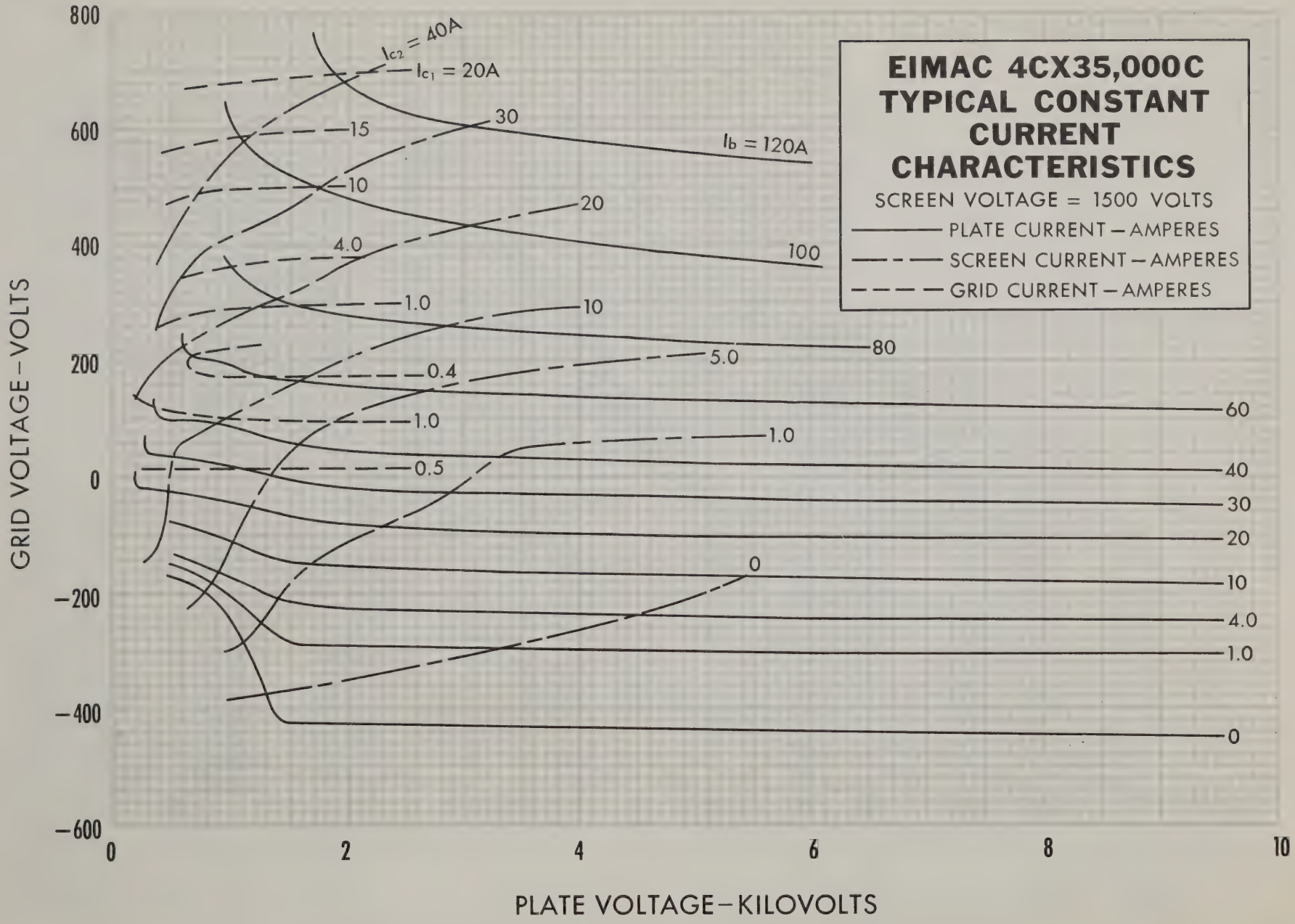
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	9.500	9.750	
B	.860	.890	
C	4.980	5.020	
D	5.980	6.020	
E	7.462	7.712	
F	13.000	13.250	
G	14.750	15.000	
H	1.750	1.800	
J	6.250	6.500	
K	1.220	1.270	
L	.690	.740	
M	.188	.228	
N	.045	.075	
P	6.510	6.560	
R	6.980	7.020	
S	7.480	7.520	
T	.485	.515	
U		.135	
V	7.975	8.015	
W	1.250	1.270	
X	.490	.530	





SECTION A-A


EIMAC 4CX35,000C
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
800
600
400
200
0
−200
−400
−600
GRID VOLTAGE – VOLTS
0
2
4
6
8
10
PLATE VOLTAGE – KILOVOLTS
I_{c_2} = 20.0A
I_{c_1} = 10A
I_b = 50.0A
10.0
6.0
5.0
2.0
1.0
1.0
0
40.0
30.0
20.0
10.0
5.00
1.00
0


EIMAC 4CX35,000C
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
PLATE VOLTAGE – KILOVOLTS
800
600
400
200
0
–200
–400
–600
0
2
4
6
8
10
I_{c_2} = 40A
I_{c_1} = 20A
I_b = 120A
30
15
10
20
4.0
100
1.0
10
80
5.0
0.4
60
1.0
1.0
0.5
40
30
20
0
10
4.0
1.0
0

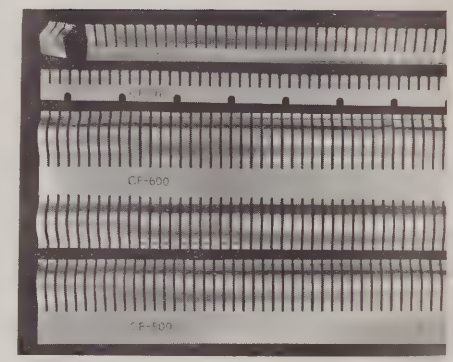
CONTACT FINGER STOCK

CF-100 THROUGH CF-900

CONTACT FINGER STOCK

EIMAC Preformed Finger Stock is a prepared strip of spring material, slotted and formed into a series of fingers, designed to make a sliding contact.

EIMAC Finger Stock provides excellent circuit continuity between components with adjustable or moving contact surfaces. It is especially suitable for making connections to tubes with coaxial terminals or to moving parts, such as long line and cavity circuits. It is also useful as an electrical "weather stripping" around doors in equipment cabinets and "screen" rooms.



The base material is a non-ferrous spring alloy, heat treated for more positive spring action and silver plated for better rf conductivity.

CF-100, CF-700, and CF-800 incorporate "spooned" fingers to prevent scratching the contact surface (see drawings on reverse side of sheet)

EIMAC Contact Finger Stock is supplied in 36-inch lengths (91 cm).

FINGER STOCK CURRENT RATING

	MINIMUM DEFLECTION		MAXIMUM CURRENT		
TYPE	INCH	MM	AMPS. PER FINGER	AMPS. PER INCH OF FINGER STOCK	AMPS. PER CM OF FINGER STOCK
CF-100	.015	(.38)	7.8	47.2	18.7
CF-200	.015	(.38)	7.8	47.2	18.7
CF-300	.025	(.63)	5.7	34.6	13.6
CF-400	.025	(.63)	5.7	34.6	13.6
CF-500	.030	(.76)	7.8	47.2	18.7
CF-600	.030	(.76)	7.8	47.2	18.7
CF-700	.015	(.38)	7.8	47.2	18.7
CF-800	.035	(.89)	6.4	38.7	15.3
CF-900	.015	(.38)	3.9	47.2	18.7

(Revised 6-15-71) © 1962, 1966, 1971 Varian Printed in U.S.A.

EIMAC Contact Finger Stock is heat treated to a minimum tensile strength of 170,000 pounds per square inch.

No further forming of the material should be attempted. The minimum bending radius of curvature for the material is 0.75 inch. It may be secured by any suitable mechanical means or by soft soldering. If torch-soldering is attempted, extreme care must be exercised to prevent overheating which will anneal the material, resulting in loss of its elastic properties.

EIMAC Contact Finger Stock is available in the following semi-finished states:

CF-101 through CF-901: Slotted and formed (Not heat treated or plated)
CF-102 through CF-902: Slotted, formed, and heat treated (Not plated)
CF-103 through CF-903: Slotted, formed, and plated (Not heat treated)

Contact Finger Stock which has not been heat treated can be formed to different shapes by the user, after which it may be heat treated.

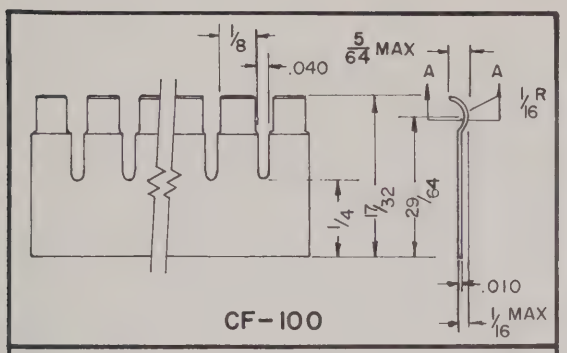
A suitable heat treating schedule consists of holding the unplated material at 600°±5°F for 2.5 hours in air, after which it must be cleaned and plated. Heat treating the material in a controlled atmosphere such as cracked natural gas, disassociated ammonia, or forming gas will minimize oxidation. Finger stock should be held in a suitable jig or fixture during heat treating to prevent deformation.

The Finger Stock current rating is based on a temperature rise of 50°C at the point of contact with one piece of finger stock making contact with another identical piece. Contact pressure is controlled by assuring that the deflection at the point of contact is at least as great as indicated in the table on page 1.

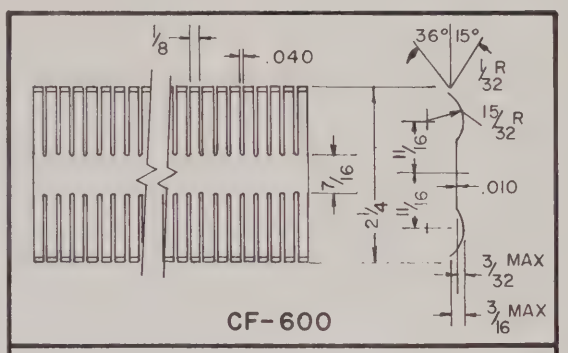
For long term operation the finger stock temperature should not exceed 150°C (300°F). The material may be heated to 260°C (500°F) for a short period such as required for soft soldering.

Temperature rise is proportional to current squared. It will be affected by the temperature of the surface to which contact is made and by the amount and temperature of cooling air if used.

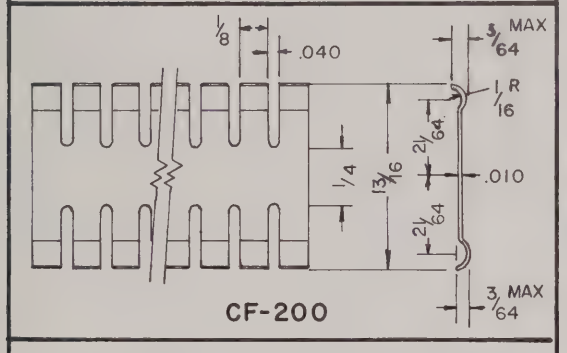
Dimensions in Inches



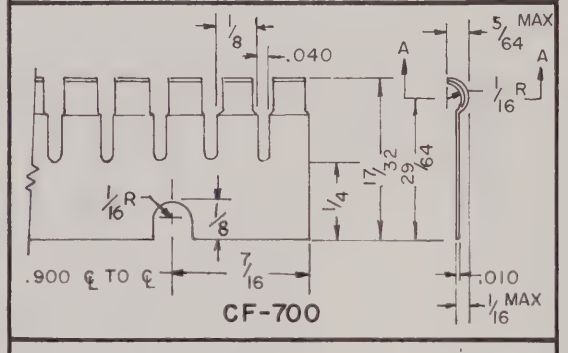
CF-100



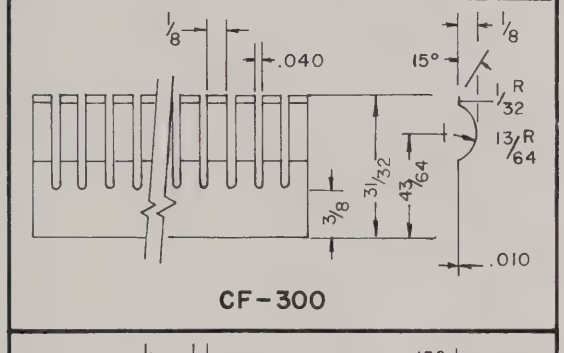
CF-600



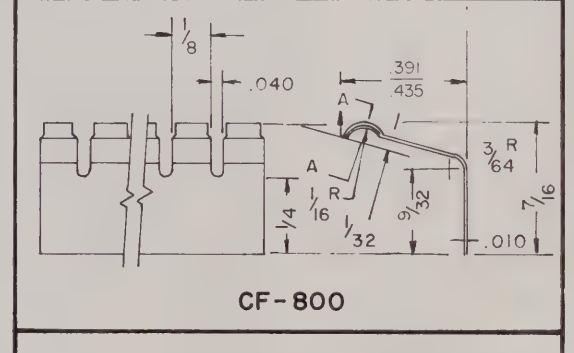
CF-200



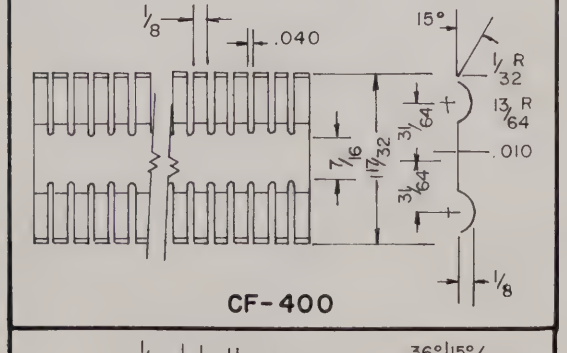
CF-700



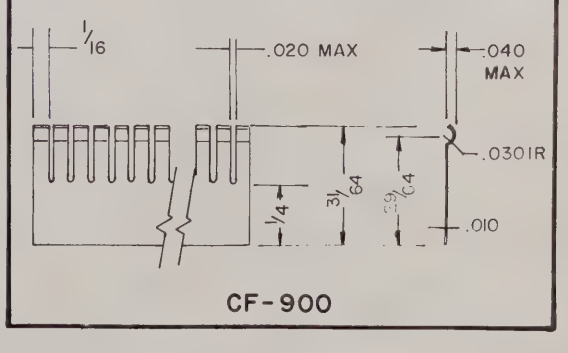
CF-300



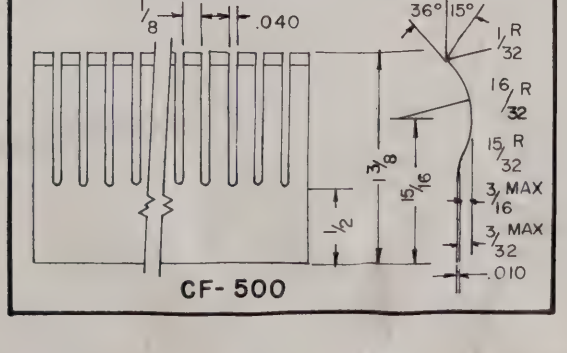
CF-800



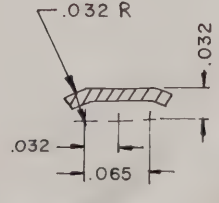
CF-400



CF-900

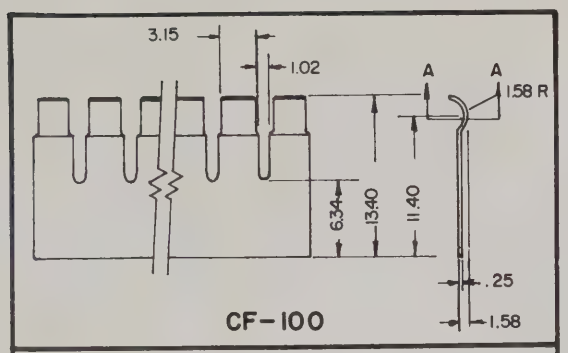


CF-500

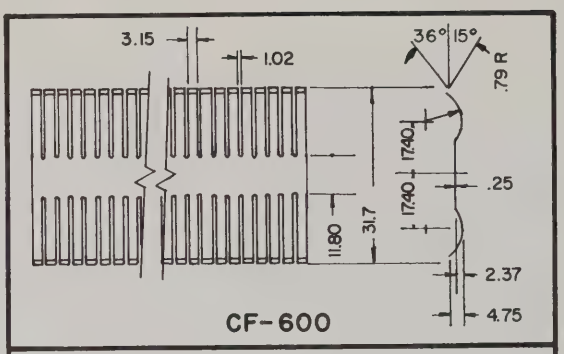


SECTION A-A
(CF 100, 700, 800)

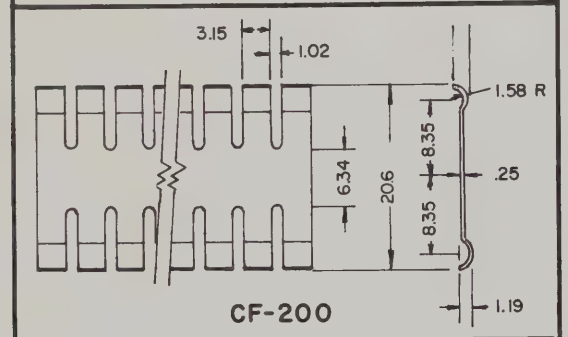
Dimensions in Millimeters



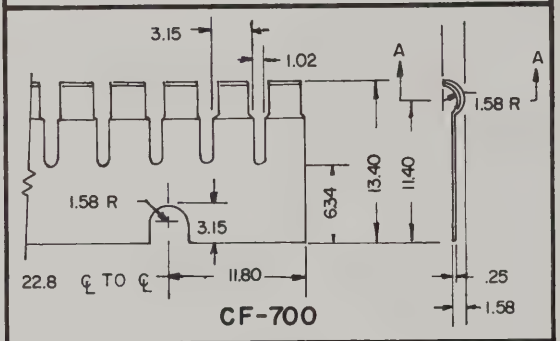
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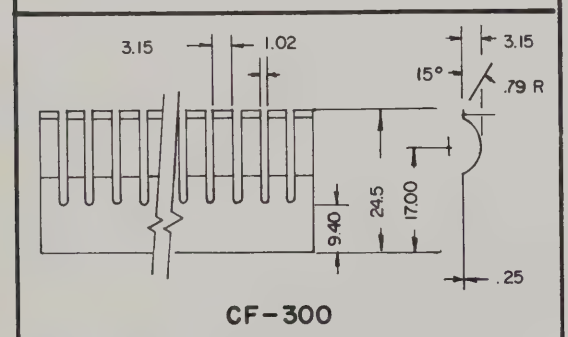
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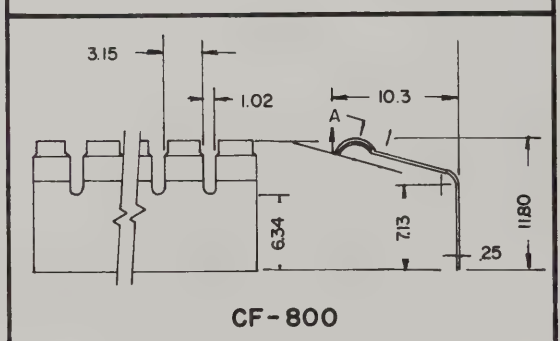
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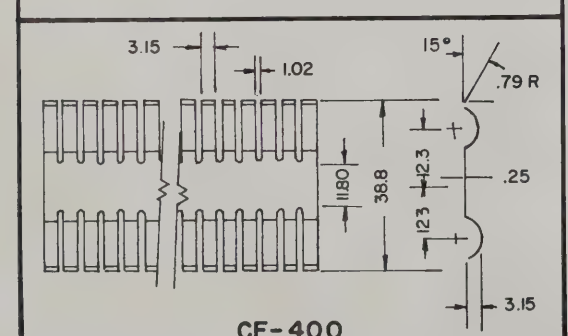
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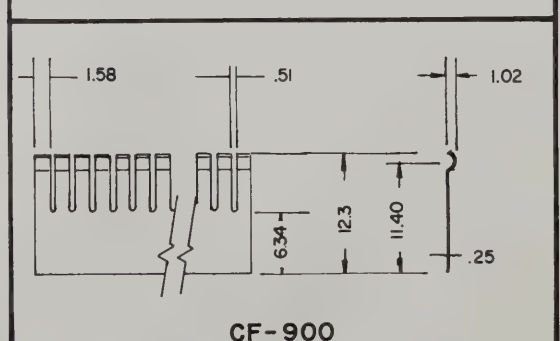
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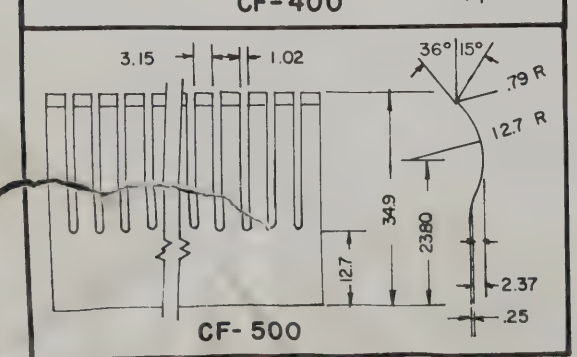
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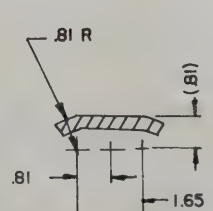
CF-400



CF-900



CF-500



SECTION A-A
(CF 100, 700, 800)

TENTATIVE DATA

4W300B

RADIAL-BEAM POWER TETRODE



The Eimac 4W300B is a compact radial-beam tetrode with a maximum plate-dissipation rating of 300 watts and a maximum input-power rating of 500 watts. Electrically identical to the Eimac 4X250B, it is intended for use where water cooling is preferred or where reserve anode dissipation is desired.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	-	30	60	seconds
Heater: Voltage	-	-	6.0	volts
Current	-	2.3	2.9	amperes
Amplification Factor (Grid-Screen)		5.2		
Transconductance (I_b=200 ma.)		12,000		umhos
Frequency for Maximum Ratings			500	mc

Interelectrode Capacitances, Grounded Cathode:*	Min.	Nom.	Max.	
Input	14.2		17.2	uuf
Output	4.0		5.0	uuf
Feedback	-	-	0.06	uuf
Interelectrode Capacitances, Grounded Grid and Screen:*				
Input	-	13.0		uuf
Output	4.0		5.0	uuf
Feedback	-	0.01		uuf

MECHANICAL

Base	9-pin, special
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175° C
Ceramic-to-Metal Seals	250° C
Cooling (See following page)	Water and forced air
Recommended Socket	Eimac SK-600 Series
Operating Position	Vertical, base down or up

MAXIMUM RATINGS

	Class-C Plate Mod	Class-C Teleg or FM	Class-AB Audio or SSB	
D-C PLATE VOLTAGE	1500	2000	2000	MAX. VOLTS
D-C SCREEN VOLTAGE	300	300	400	MAX. VOLTS
D-C GRID VOLTAGE	-250	-250	...	MAX. VOLTS
D-C PLATE CURRENT	200	250	250	MAX. MA
PLATE DISSIPATION	200	300	300	MAX. WATTS
SCREEN DISSIPATION	12	12	12	MAX. WATTS
GRID DISSIPATION	2	2	2	MAX. WATTS

*In Shielded Fixture.

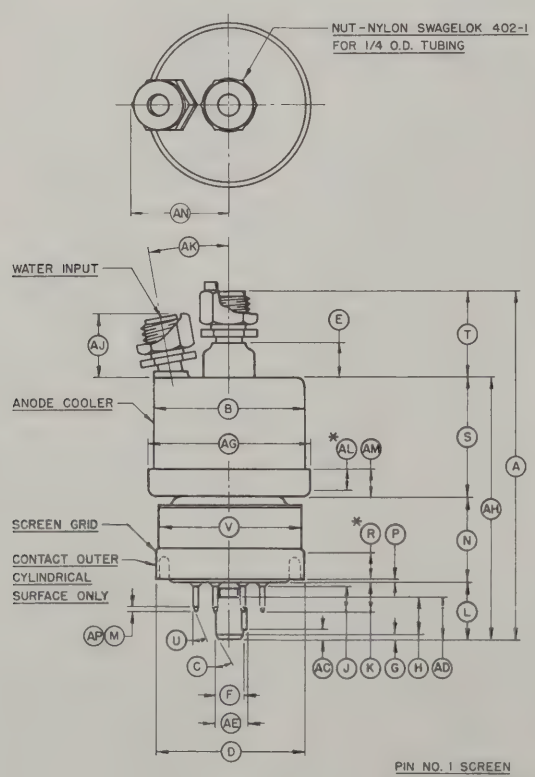
(Effective 6-15-60) Copyright 1960 by Eitel-McCullough, Inc.

TYPICAL OPERATION	D-C Plate Voltage (Volts)	Power Input (Watts)	Driving Power (Watts)	Power Output (Watts)
Class-C Amplifier				
Telegraphy or FM	2000	500	3	390
Plate Modulated	1500	300	2	235
Class-AB_1 Amplifier				
Audio (Two tubes)	2000	1000	0	600
SSB (One tube)	2000	500	0	300

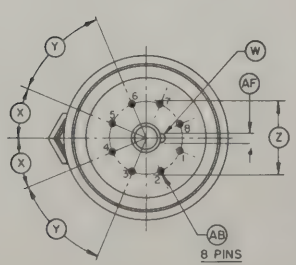
COOLING

The water-cooled anode requires a minimum of 1/16 gallon of cooling water per minute for the rated plate dissipation of 300 watts. The outlet-water temperature should not exceed 70° C and the system pressure should not exceed 50 pounds per square inch. The pressure drop across the cooler with the specified flow is approximately 0.02 pounds per square inch.

The glass-to-metal seals and the ceramic-to-metal seals must be cooled by forced air. At frequencies below 30 megacycles and when one of the recommended sockets is used, a flow rate of 1.0 CFM is sufficient. As the operating frequency is increased, the air-flow rate must be increased. At 500 megacycles a minimum of 3.8 CFM is required. In all cases, seal temperatures are the criteria which determine cooling effectiveness.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A			3.407
B		1.450	1.490
C	30°		
D		1.417	1.433
E	.244		
F		.255	.265
G	.031		
H		.360	
J		.187	
K			250
L		.514	.554
M	.035		
N		.750	.810
P	.020		
R		.187	
S		1.106	1.186
T		.797	.857
U	22.5°		
V			1.406
W			.043R
X	22.5°		
Y	45°		
Z		.680	.694
AB		.045	.053
AC		.068	.108
AD			.456
AE		.298	.308
AF		.078	.086
AG			1.562
AH			2.550
AJ	.670		
AK	10°		
AL		.156	
AM	.250		
AN			1.063
AP		.005R ALT. TO M & U	



PIN NO. 1 SCREEN
PIN NO. 2 CATHODE
PIN NO. 3 HEATER
PIN NO. 4 CATHODE
PIN NO. 5 I.C. (DO NOT USE FOR EXTERNAL CONN.)
PIN NO. 6 CATHODE
PIN NO. 7 HEATER
PIN NO. 8 CATHODE
CENTER PIN - CONTROL GRID

NOTES:
1. DIMENSIONS IN INCHES.
2. (*) LENGTH AVAILABLE FOR CONTACT.

Printed in U.S.A. 82587

Eimac®

EITEL-McCULLOUGH, INC.

8173
4W20,000A
RADIAL-BEAM POWER TETRODE



The Eimac 8173/4W20,000A is a high-power, water-cooled transmitting tetrode having a maximum plate dissipation rating of 20 kilowatts. This tube will operate efficiently as a power-amplifier at frequencies up to 250 Mc. A single 8173/4W20,000A operating as a television visual r-f amplifier will deliver a synchronizing power output of 26 kilowatts at 216 Mc., with a 5-Mc. bandwidth.

The coaxial terminal arrangement of the tube is ideally suited for use in cavity circuits. The cathode is a unipotential thoriated tungsten cylinder of rugged construction, heated by electron bombardment.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, thoriated tungsten. Heated by electron bombardment.	
	D-C Voltage (Approx.)	1400 volts
	D-C Current (Approx.)	1.8 amperes
Filament:	Thoriated Tungsten, Helical	
	Voltage	10 volts
	Current (without cathode bombardment)	30 amperes
	Current (with cathode bombardment)	25 amperes
	Maximum allowable starting current	50 amperes
Direct Interelectrode Capacitances (Average)		
	Grid-Plate	0.5 $\mu\mu$f
	Input	125 $\mu\mu$f
	Output	23 $\mu\mu$f
Screen-Grid Amplification Factor (Average)		5.5
Transconductance (I_b=6.6 A., E_b=3.0 kV., E_{c2}=1200 V.)		75,000 μmhos

MECHANICAL

Base	Special, Concentric
Mounting Position	Vertical, base down or up
Cooling	Water and Forced Air
Maximum Over-all Dimensions	
Length	15.2 inches
Diameter	5.0 inches
Net Weight	7.6 pounds
Shipping Weight	40 pounds

RADIO FREQUENCY POWER AMPLIFIER MAXIMUM RATINGS (per tube)

D-C PLATE VOLTAGE	8 MAX. KV
D-C PLATE CURRENT	15 MAX. AMP
PLATE DISSIPATION	20 MAX. KW
SCREEN DISSIPATION	200 MAX. WATTS
GRID DISSIPATION	60 MAX. WATTS

TYPICAL OPERATION

Class-C Telegraphy or FM Telephony (Per tube—220 Mc.)

D-C Plate Voltage	5000	6000	7000	volts
D-C Screen Voltage	1200	1200	1200	volts
D-C Grid Voltage	—350	—370	—400	volts
D-C Plate Current	3.6	3.6	3.4	amps
D-C Screen Current (approx.)*	167	167	167	ma
D-C Grid Current (approx.)	50	50	50	ma
Peak R-F Input Voltage	455	475	505	volts
Driving Power (approx.)*	750	780	830	watts
Screen Dissipation	200	200	200	watts
Plate Power Input	18	21.6	23.8	kw
Plate Dissipation	7.0	8.6	8.0	kw
Useful Power Output	9.2	11.5	13.0	kw

*The performance figures listed above are obtained by calculation from the characteristic tube curves and confirmed by direct tests. The driving power and output power allow for losses associated with practical resonant circuits.

▶ Indicates change from sheet dated 2-1-61.

TYPICAL OPERATION

Class-B Linear Amplifier—Television Visual Service
(Per tube, 5-Mc. Bandwidth up to 216 Mc.)

Peak Synchronizing Level		
Load Impedance	650	ohms
Effective Length of Plate Line	¼	wave
D-C Plate Voltage	7000	volts
D-C Screen Voltage	1200	volts
D-C Control Grid Voltage	—150	volts
D-C Plate Current	6.0	amps
D-C Screen Current (approx.)	230	ma
D-C Control Grid Current (approx.)	90	ma
Peak R-F Grid Input Voltage	280	volts
Driving Power (approx.)	500	watts
Plate Power Input	42	kw
Plate Dissipation	16	kw
Useful Plate Power Output	26	kw
Black Level		
D-C Plate Current	4.5	amps
D-C Screen Current	100	ma
D-C Control Grid Current (approx.)	45	ma
Peak R-F Grid Input Voltage	220	volts
Driving Power (approx.)	300	watts
Plate Power Input	32	kw
Plate Dissipation	16.5	kw
Useful Power Output	15.5	kw

These 216 Mc. typical performance figures were obtained by direct measurement in test equipment. The output power is useful power measured in a load circuit. The driving power is that taken by the tube and a practical resonant grid circuit. These figures are subject to variation and in many cases, with further refinement and improved techniques, better performance might be obtained.

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Note: Typical operation data are based on conditions of adjusting to a specificied plate current, maintaining fixed conditions of grid bias, screen voltage, suppressor voltage and r-f grid voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid, screen and suppressor currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

APPLICATION

Mounting—The 4W20,000A must be mounted vertically. Base-down or base-up mounting is optional.

The co-axial contact surfaces provided for connection to the filament, cathode, grid, screen, and anode are of successively larger diameters to facilitate removal and replacement of tubes.

Cavity circuits may be designed around the dimensions shown in the outline drawing. At very high frequencies the points of contact between the tube and the external circuit will be required to carry high values of charging current. It is, therefore, essential that the contactors make firm and uniform contact between the terminal surfaces of the tube and the external circuit. Particular care should be taken that the contactors are not inadvertently forced out of shape, and that all contact surfaces are maintained free from dust or other foreign matter which would prevent uniform electrical connection. At VHF, poor contact by one finger of a multi-finger collet can result in local overheating which may damage the tube seals.

Although contact fingers or slotted collets are often made an integral part of cavity circuits, there is some advantage to reversing the plan by providing contact-finger assemblies which are designed to be clamped firmly to the terminal surfaces of the tube itself and to make sliding contact with the cavity as the tube is inserted. This arrangement facilitates replacement of worn or damaged contactors and tends to remove incidental local heating from the vicinity of the tube seals. Tubes held in reserve for emergency replacement may be fitted with contact finger assemblies and water-line extensions to minimize lost time in making changes.

Cathode Heating Power — The cathode of the 4W20,000A is a unipotential, thoriated tungsten cylinder, heated by electron bombardment of its inner surface. Bombardment is obtained by using the cylindrical cathode as the anode of a diode. A helical filament is mounted on the axis of the cathode cylinder to supply the bombarding electrons. A d-c potential of approximately 1400 volts is applied between the filament and the cathode cylinder, and the recommended cathode heating power of 2500 watts is obtained with approximately 1.8 amperes.

The inner filament is designed to operate under space-charge limited conditions so that the cathode temperature may be varied by changing the voltage applied between the inner filament and the cathode cylinder.

For maximum tube life the filament voltage, as measured directly at the filament terminals, must be reduced after the cathode has reached operating temperature. The proper filament voltage for a given cathode bombardment power may be found in the table below. The filament voltage should remain at the 10.0-volt value until the cathode has reached operating temperature, an interval of approximately thirty seconds. The filament voltage should be maintained to within 5% of the proper operating value and the cathode bombardment power should be held within plus or minus 100 watts of the recommended value.

Cathode Bombardment Power	2000	2250	2500	2750	3000
Filament Voltage	6.0	5.2	4.3	3.2	2.0

A cathode bombardment power of 2250 watts is normal for average CW conditions. In applications requiring peak values of cathode current in excess of 75 amperes the cathode bombardment power may be increased to a value between 2250 and 3000 watts as required.

Further increases in cathode efficiency will result in a decrease in the cathode bombardment power requirements. The cathode bombardment power supply should, therefore, be capable of providing a minimum of approximately 2000 watts.

Caution: It must be kept in mind that the filament is at a potential of 1400 volts d-c with respect to ground. The filament transformer and voltmeter must be adequately insulated for this voltage.

Grid Voltage Regulation—The practice of designing grid voltage supplies to maintain adequate regulation under conditions of varying grid current is particularly desirable with the 4W20,000A. Because the cathode of the 4W20,000A is a complete cylinder, grid temperatures run higher than usual. For this reason, even with no excitation, control grid current reversal might conceivably be several milliamperes and safe design should allow for possible peaks on the order of 100 milliamperes.

Anode Cooling—The water-cooled anode requires 8 gallons per minute of cooling water for the rated 20 kilowatts of plate dissipation. This corresponds to a pressure drop of 7 pounds per square inch across the water jacket. The inlet water pressure must not exceed a maximum of 50 pounds per square inch.

The outlet water temperature must not exceed a maximum of 70°C under any conditions.

Seal Cooling—The grid and screen tube contact surfaces and adjacent glass and ceramic must be cooled by high-velocity air which may be accomplished by means of ring manifolds. The quantity, velocity and direction of air must be adjusted to limit the maximum seal temperatures to 150°C.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

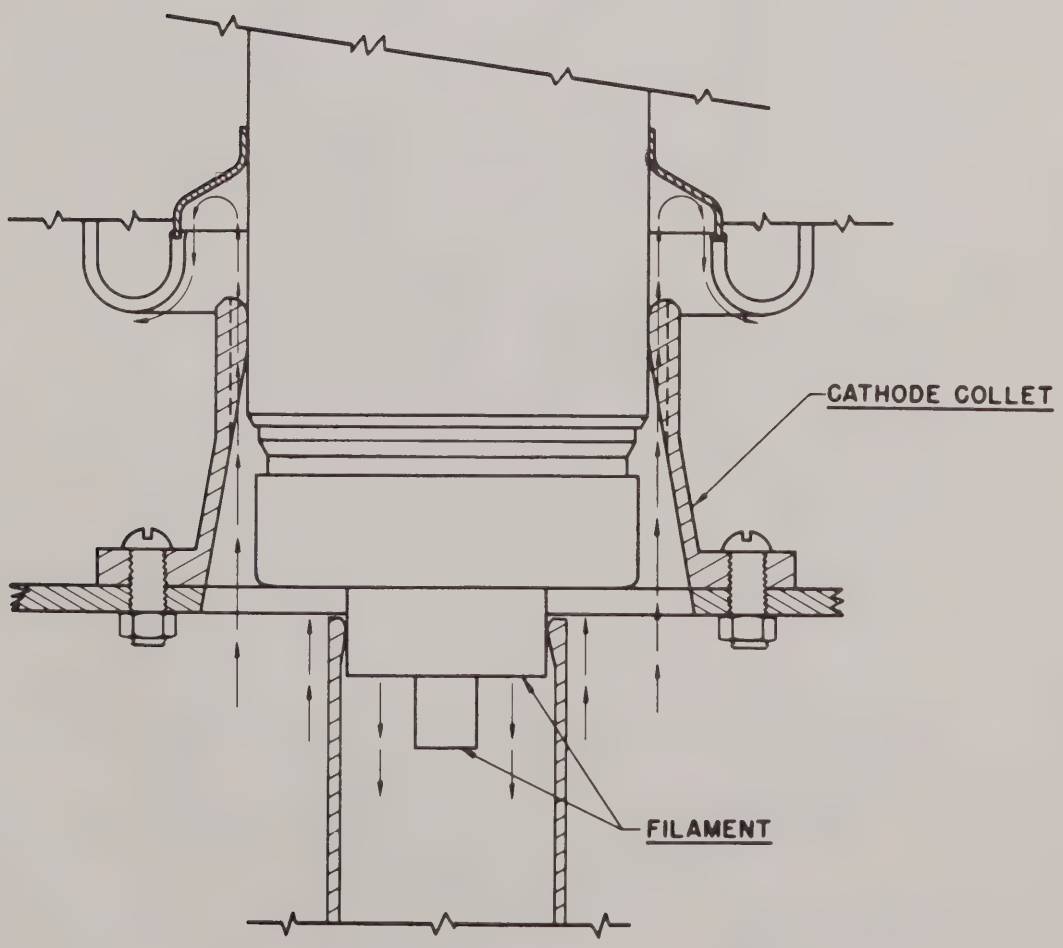
The cathode and filament stem also require forced-air cooling in sufficient quantity so that the region on the cathode terminal opposite the glass of the grid terminal seal does not exceed a maximum of 150°C. The major portion of this air must be guided along the surface of the terminal sleeve. The remaining air flows through the nine holes inside the terminal sleeve, cools the filament stem and vents through the three holes in the tube base enclosed by the outer filament spring collet connection.

By employing a cathode collet such as is shown in the accompanying drawings, the recommended cooling requirements will be fulfilled with an air flow of 60 cubic feet per minute at a static manifold pressure of 2 inches of water column.

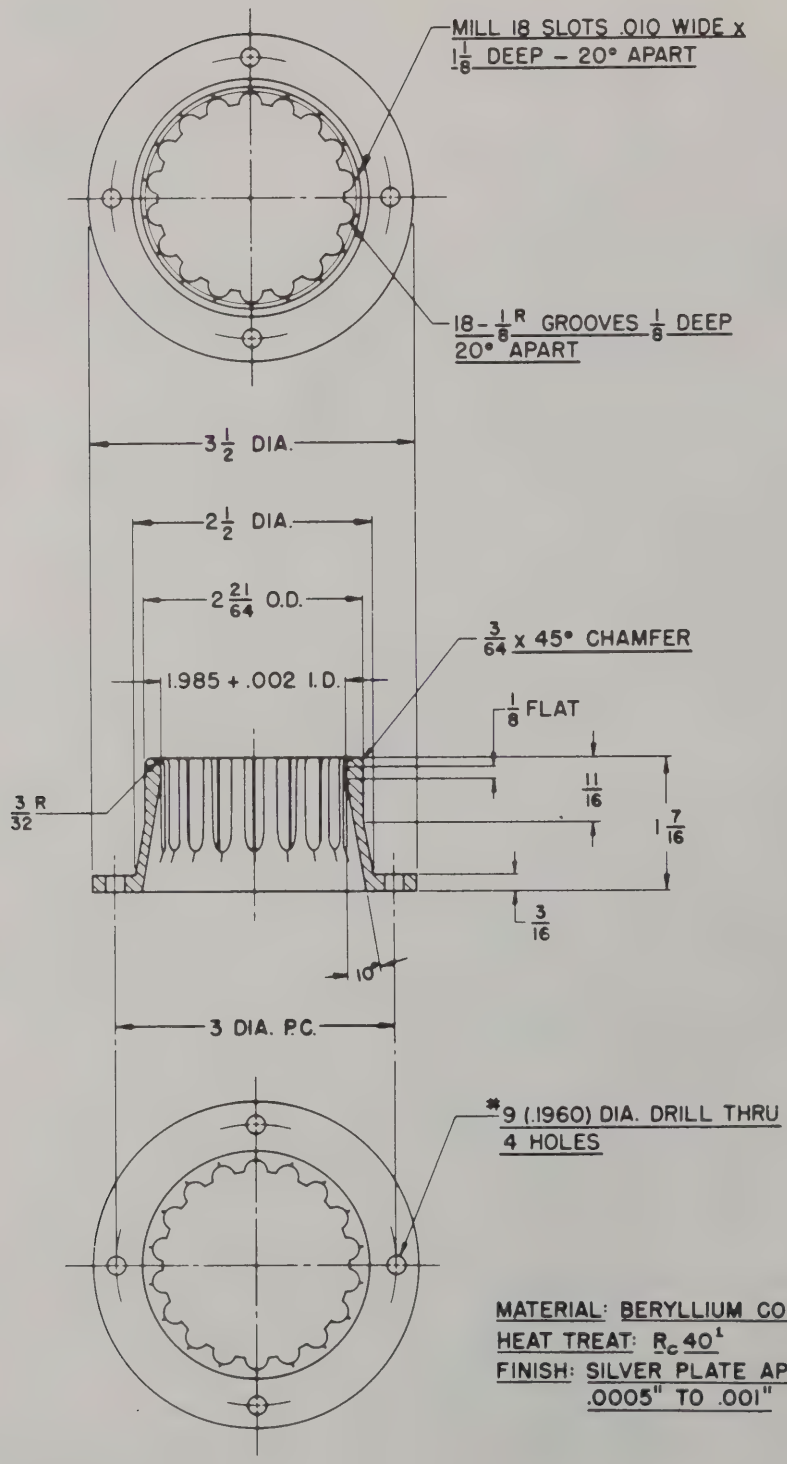
Air and water flow must be started before filament and cathode power are applied and maintained for at least two minutes after the filament and cathode power have been removed.

4W20,000A

SUGGESTED STEM AIR COOLING

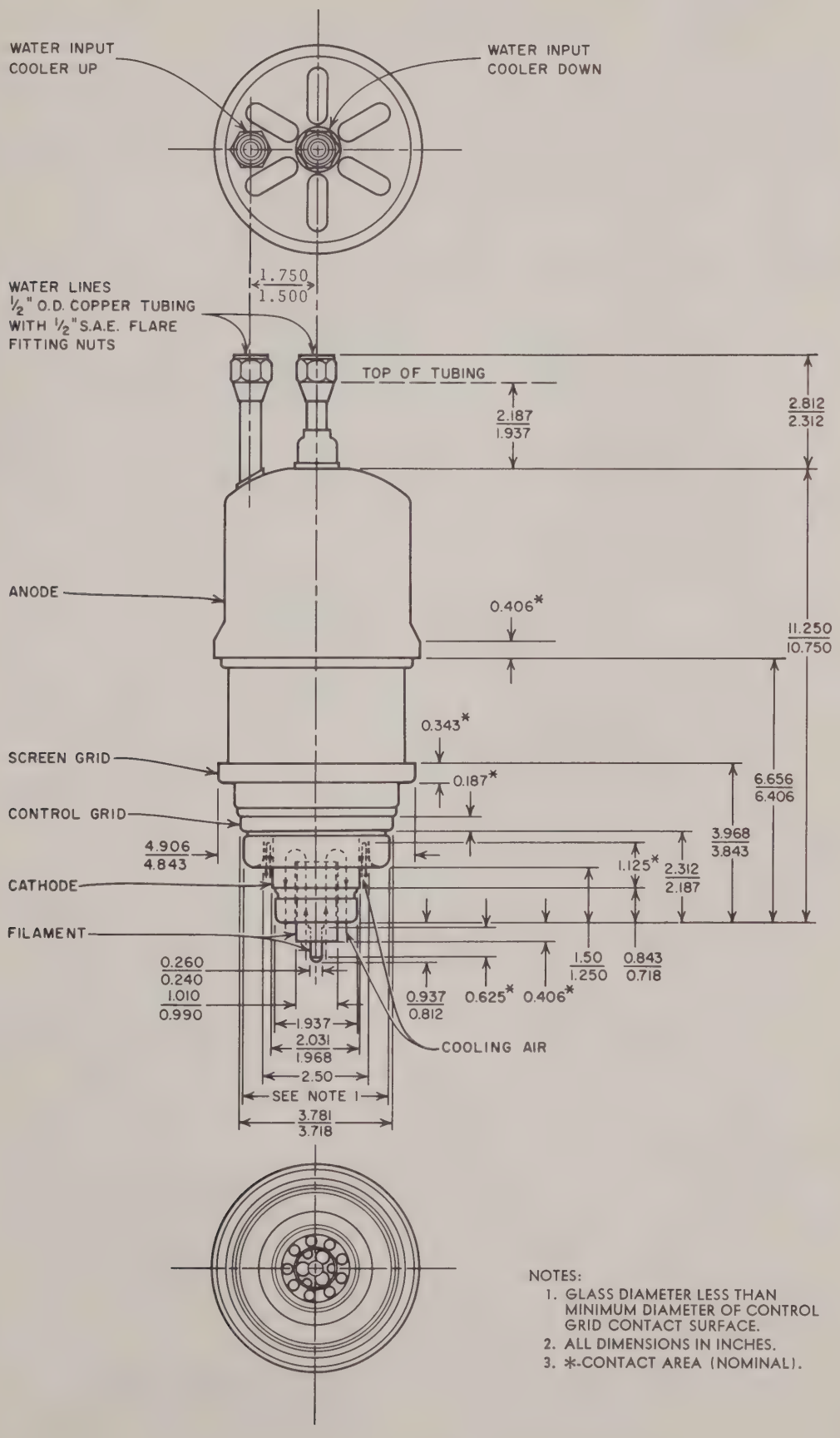


4W20,000A
CATHODE COLLET



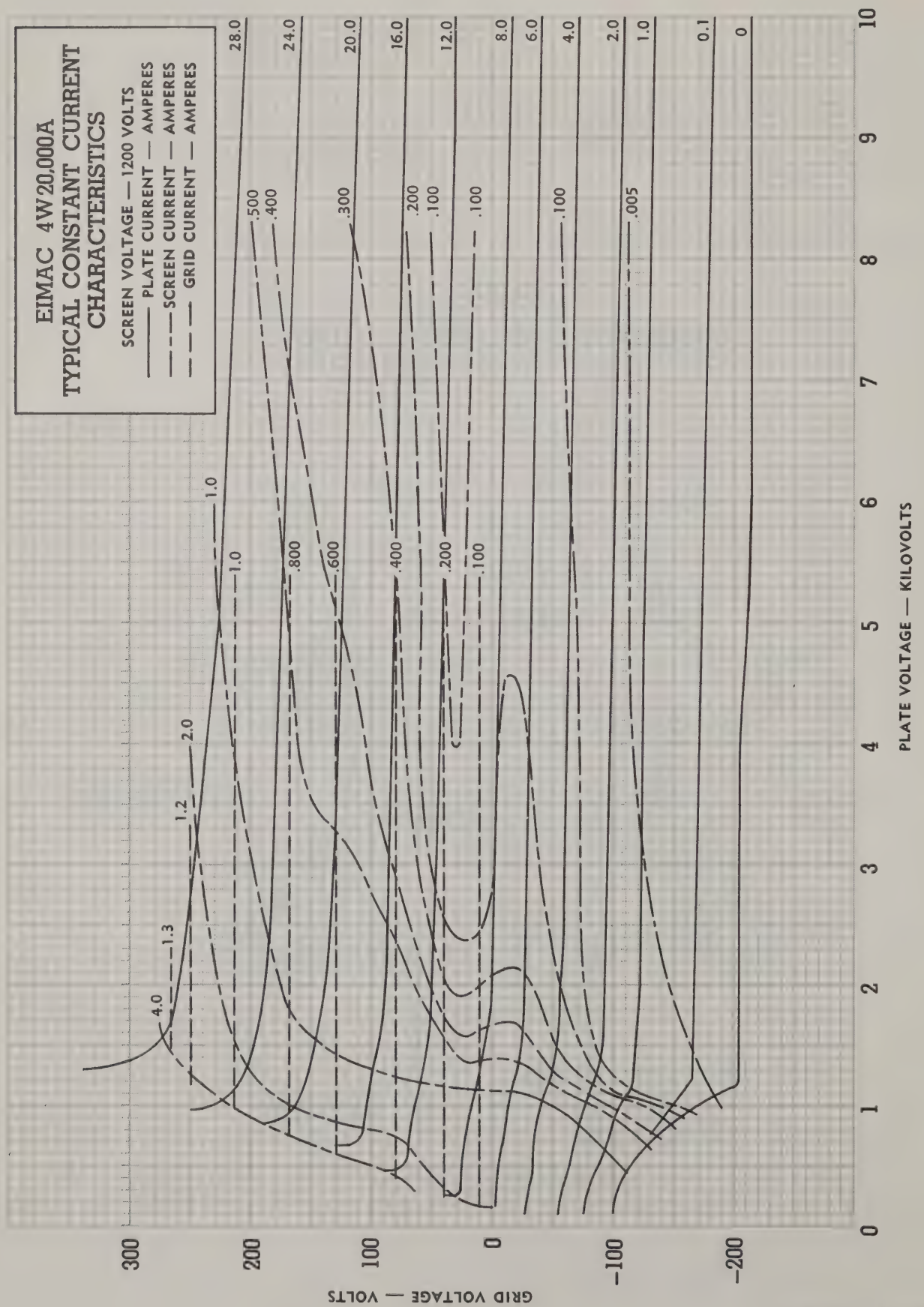
MATERIAL: BERYLLIUM COPPER
HEAT TREAT: R_C 40[1]
FINISH: SILVER PLATE APPROX. .0005" TO .001"

[1] 385°C FOR APPROX. 5-6 HRS. IN NON-REDUCING ATMOSPHERE



NOTES:

1. GLASS DIAMETER LESS THAN MINIMUM DIAMETER OF CONTROL GRID CONTACT SURFACE.
2. ALL DIMENSIONS IN INCHES.
3. *-CONTACT AREA (NOMINAL).



Printed in U.S.A. 194A

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

7034 / 4X150A
7035 / 4X150D

RADIAL-BEAM POWER TETRODE

The 7034/4X150A and 7035/4X150D are forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts up to 150 MHz, with reduced ratings applicable to 500 MHz. The 7034/4X150A is designed to operate with a heater voltage of 6.0 volts, while the 7035/4X150D is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage (4X150A)	6.0 ± 0.6	V
Current, at 6.0 volts	2.6	A
Cathode - Heater Potential	±150	V
Heater: Voltage (4X150D)	26.5 ± 2.6	V
Current at 26.5 volts	0.56	A
Cathode Heater Potential	±150	V
Amplification Factor (Average):		
Grid to Screen	5	
Direct Interelectrode Capacitances (Grounded Cathode)[2]		
Input	15.7	pF
Output	4.5	pF
Feedback	0.03	pF
Frequency of Maximum Rating:	150	MHz
Highest Useful Frequency:	500	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the results of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.414 in; 61.32 mm
Diameter	1.640 in; 41.66 mm
Net Weight	4 oz; 113 gm
Operating Position	Any

(Revised 5-4-70) © 1962 Varian Printed in U.S.A.

Maximum Operating Temperature: Base Seals	175 °C
Anode Seal	200 °C
Anode Core	250 °C
Cooling	Forced Air
Base	Special 9-pin JEDEC-B8-236
Recommended Socket	EIMAC SK-600 Series
Recommended Chimney	EIMAC SK-600 Series

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN (SSB)

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE [1]	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

1. Dc plate voltage rating is 1250 volts above 150 MHz.

TYPICAL OPERATION (Frequencies to 150 MHz)
Class AB1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [2]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Single Tone Plate Current	250	250	250	mAdc
Two-Tone Plate Current	190	190	190	mAdc
Single-Tone Screen Current [3]	10	8	5	mAdc
Two-Tone Screen Current [3]	2	-1	-2	mAdc
Single-Tone Grid Current [3]	0	0	0	mAdc
Peak rf Grid Voltage [3]	50	50	50	v
Plate Output Power	120	215	300	W
Resonant Load Impedance	1750	3100	4750	Ω

2. Adjust to specified zero-signal dc plate current.
3. Approximate value.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN, CARRIER CONDITIONS

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE [1]	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

1. Dc plate voltage rating is 1250 volts above 150 MHz.

TYPICAL OPERATION (Frequencies to 150 MHz)
Class AB_1, Grid Driven

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage [2]	-55	-55	-55	Vdc
Zero-Signal Plate Current	100	100	100	mAdc
Carrier Plate Current	150	150	150	mAdc
Carrier Screen Current	-3	-4	-4	mAdc
Peak rf Grid Voltage [3]	25	25	25	v
Plate Output Power	30	50	65	W

2. Adjust to specified zero-signal dc plate current.
3. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE [1]	2000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.25 AMPERE
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

1. Dc plate voltage rating is 1250 volts above 150 MHz.

TYPICAL OPERATION (Frequencies to 150 MHz)

					500 MHz [3]	
Plate Voltage	500	1000	1500	2000	1250	Vdc
Screen Voltage	250	250	250	250	250	Vdc
Grid Voltage	-90	-90	-90	-90	-80	Vdc
Plate Current	250	250	250	250	200	mAdc
Screen Current [2]	45	38	21	19	7	mAdc
Grid Current [2]	35	31	28	26	10	mAdc
Peak rf Grid Voltage [2]	114	114	112	112	---	v
Measured Driving Power [2]	4.0	3.5	3.2	2.9	10	W
Plate Input Power	125	250	375	500	250	W
Plate Output Power	70	190	280	390	140	W [2]
Heater Voltage	6.0	6.0	6.0	6.0	(4)	

2. Approximate value.
3. Measured values for a typical cavity amplifier circuit.
4. Heater voltage reduced to 5.5 volts and 24.3 volts for the 4X150A and 4X150D respectively.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

MAXIMUM RATINGS:

DC PLATE VOLTAGE[1]	1600	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.20	AMPERE
PLATE DISSIPATION[2]	165	WATTS
SCREEN DISSIPATION[3]	12	WATTS
GRID DISSIPATION[3]	2	WATTS

1. Dc plate voltage rating is 1250 volts above 150 MHz.
2. Corresponds to 250 watts at 100% sine-wave modulation.
3. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 150 MHz)

Plate Voltage	500	1000	1600	Vdc
Screen Voltage	250	250	250	Vdc
Grid Voltage	-100	-100	-100	Vdc
Plate Current	200	200	200	mAdc
Screen Current[4]	25	20	18	mAdc
Grid Current[4]	23	21	21	mAdc
Peak rf Grid Voltage[4]	173	172	172	v
Calculated Driving Power[4]	4.0	3.6	3.6	W
Plate Input Power	100	200	320	W
Plate Output Power	47	140	250	W

4. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR

Class AB_1, Grid Driven (Sinusoidal Wave)

MAXIMUM RATINGS (Per Tube):

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.25	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Approximate value.
2. Per Tube.

TYPICAL OPERATION (Two Tubes)

Plate Voltage	1000	1500	2000	Vdc
Screen Voltage	350	350	350	Vdc
Grid Voltage[1/3]	-55	-55	-55	Vdc
Zero-Signal Plate Current	200	200	200	mAdc
Max Signal Plate Current	500	500	500	mAdc
Max Signal Screen Current[1]	20	16	10	mAdc
Max Signal Grid Current[1]	0	0	0	mAdc
Peak af Grid Voltage[2]	50	50	50	v
Peak Driving Power	0	0	0	W
Plate Input Power	500	750	1000	W
Plate Output Power	240	430	600	W
Load Resistance (Plate to Plate)	3500	6200	9500	Ω

3. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Nom.	Max	
Heater: 4X150A Current at 6.0 volts	2.3	---	2.9	A
Heater: 4X150D Current at 26.5 volts	0.50	---	0.62	A
Cathode Warmup Time	30	60	---	sec
Interelectrode Capacitances[1] (grounded cathode connection)				
Input	14.5	---	17.0	pF
Output	4.0	---	4.8	pF
Feedback	---	---	0.05	pF

1. In shielded fixtures.

APPLICATION

MECHANICAL

MOUNTING - The 4X150A and 4X150D may be operated in any position. An EIMAC Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

COOLING - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the EIMAC SK-600 series and an EIMAC SK-606 chimney are used with air flow in the base to anode direction.

SEA LEVEL			10,000 FEET	
Plate Dissipation(watts)	Air Flow (CFM)	Pressure Drop(In. of water)	Air Flow (CFM)	Pressure Drop(In. of water)
200	5.2	0.58	7.8	0.85
250	6.1	0.79	9.0	1.10

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 MHz or below, base cooling air requirements are satisfied automatically when the tube is operated in an EIMAC Air-System Socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

VIBRATION - These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration more severe than this is expected, it is suggested that the EIMAC 4CX300A or 4CX250R be employed.

ELECTRICAL

HEATER - The rated heater voltage for the 4X150A and 4X150D is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ± 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the table below:

Frequency MHz	4X150A	4X150D
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.3 volts
401 to 500	5.50 volts	24.3 volts

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 mA for plate-modulated operation and 250 mA for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

GRID OPERATION - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving-power requirements for

amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid-current values below approximately 15 mA.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4X150A or 4X150D.

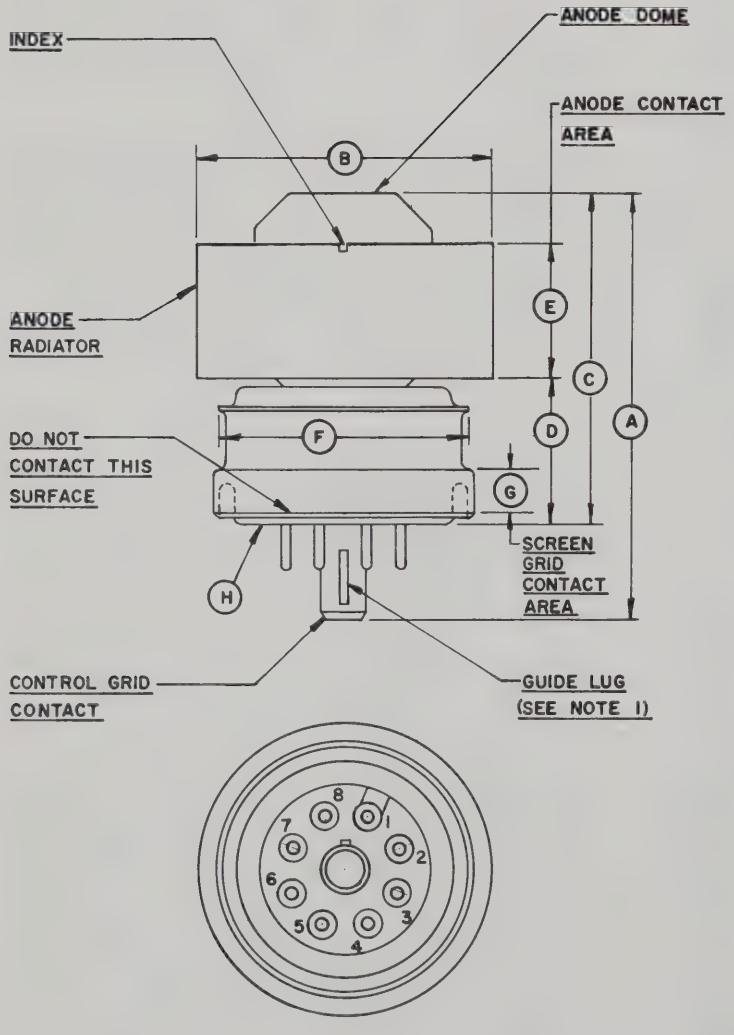
PLATE OPERATION - The maximum rated plate dissipation power is 250 watts. In plate-modulated applications the carrier plate dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

VHF OPERATION - The 4X150A and 4X150D are suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

SPECIAL APPLICATIONS-If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Dept., EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.



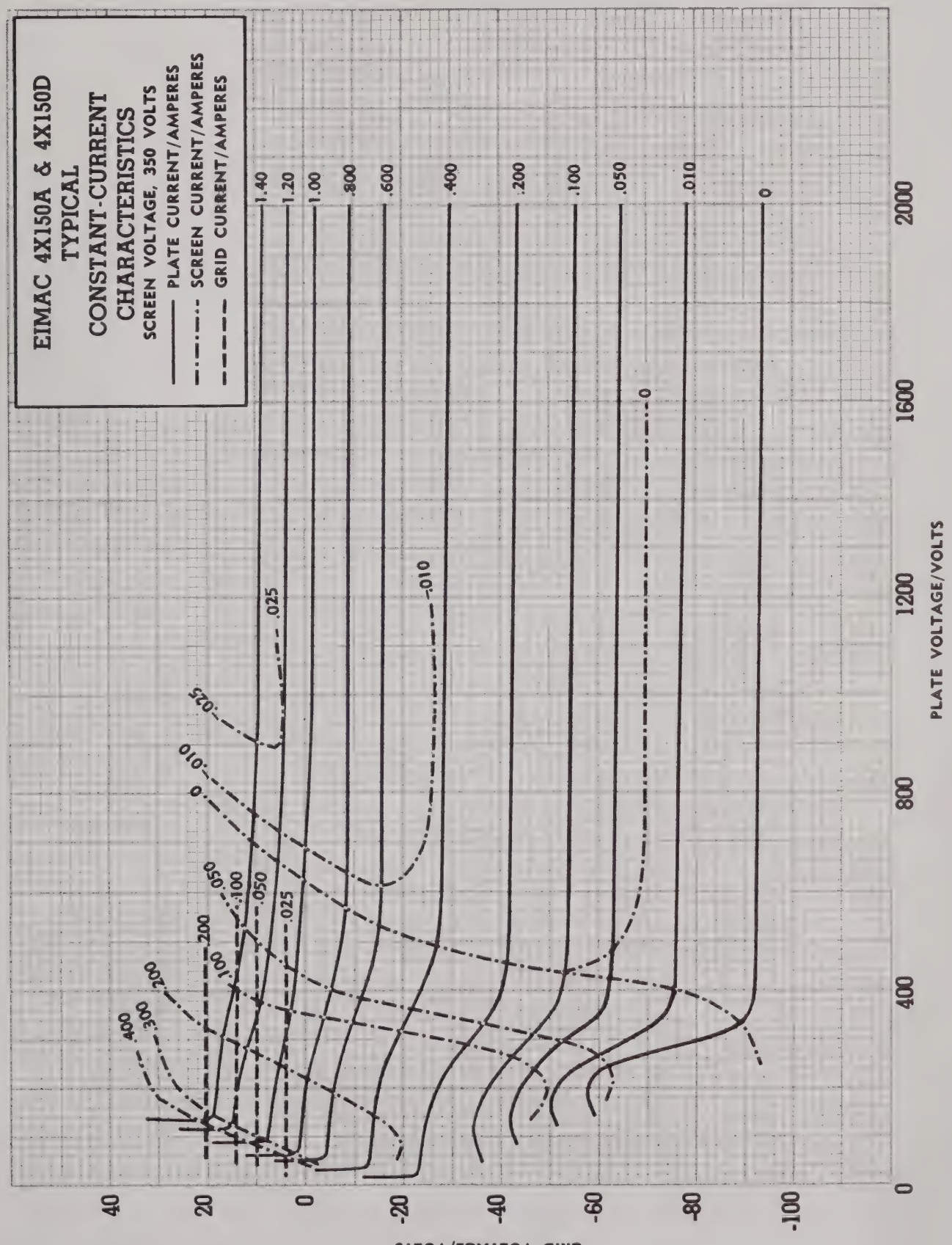
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	NOM.	MIN.	MAX.	NOM.
A	2.224	2.414		59.03	62.59	
B	1.610	1.640		40.89	41.65	
C	1.710	1.860		43.43	47.24	
D	.750	.810		19.05	20.57	
E	.710	.790		18.03	20.07	
F		1.406			35.71	
G	.187			4.75		
H	BASE: B8-236 (JEDEC DESIGNATION)					

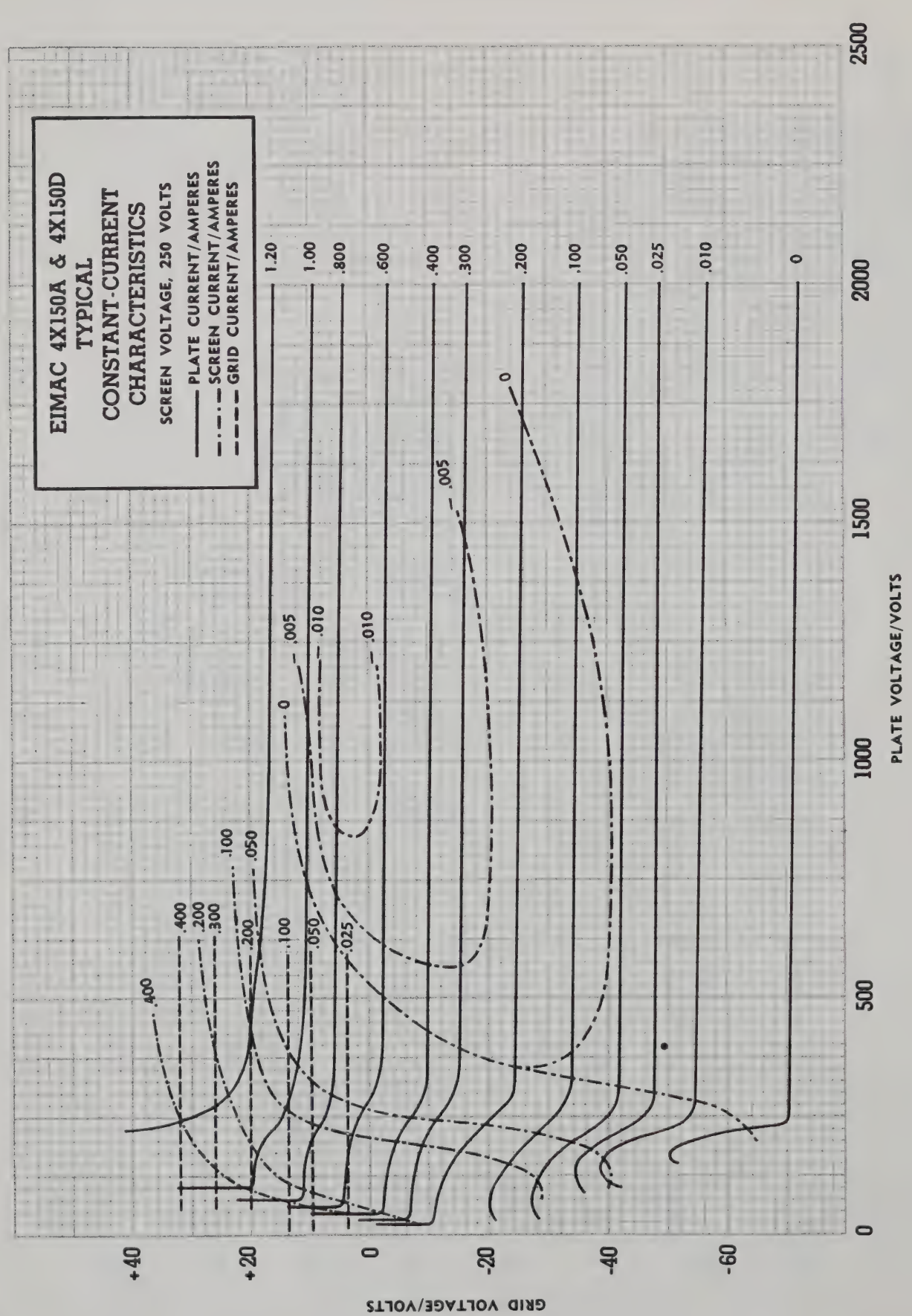
NOTES:

1. LOCATION OF GUIDE LUG OF CONTROL GRID CONTACT MAY BE REFERENCED BY AN ARROW OR NOTCH ON THE ANODE RADIATOR IN THE POSITION SHOWN.

PIN DATA

PIN NO. 1 SCREEN GRID
PIN NO. 2 CATHODE
PIN NO. 3 HEATER
PIN NO. 4 CATHODE
PIN NO. 5 I.C.-DO NOT USE FOR EXTERNAL CONNECTION
PIN NO. 6 CATHODE
PIN NO. 7 HEATER
PIN NO. 8 CATHODE
CENTER PIN-CONTROL GRID


EIMAC 4X150A & 4X150D
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT/AMPERES
SCREEN CURRENT/AMPERES
GRID CURRENT/AMPERES
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.025
.010
0
.050
.100
.050
.025
.200
.100
.200
.300
.400
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
GRID VOLTAGE/VOLTS
PLATE VOLTAGE/VOLTS


EIMAC 4X150A & 4X150D
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT/AMPERES
SCREEN CURRENT/AMPERES
GRID CURRENT/AMPERES
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
.010
.005
0
.400
.200
.300
.100
.200
.100
.050
.025
0
+40
+20
0
-20
-40
-60
GRID VOLTAGE/VOLTS
0
500
1000
1500
2000
2500
PLATE VOLTAGE/VOLTS

EITEL-McCULLOUGH, INC.

8296
4X150R
8297
4X150S

RADIAL-BEAM POWER TETRODE

The Eimac 8296/4X150R and 8297/4X150S are compact radial-beam tetrodes designed for use as amplifiers, oscillators, or frequency multipliers (up to 500 megacycles) in applications where shock and/or vibration preclude the use of non-ruggedized types. The 8296/4X150R is designed to operate with a heater voltage of 6.0 volts, while the 8297/4X150S is designed for operation at a heater voltage of 26.5 volts. Otherwise the two tubes have identical characteristics.

The 8296/4X150R and 8297/4X150S will replace the 4X150A and 4X150D in almost all applications since they are electrically identical except for a slight increase in heater current and a small increase in input and output capacitance limits. The 8296/4X150R and 8297/4X150S will operate with maximum rated plate and screen voltages applied in equipments where shock and/or vibration is experienced. See Shock and Vibration section on page three for details.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage 4X150R		6.0		
Current 4X150R	2.4		3.0	amperes
Voltage 4X150S		26.5		volts
Current 4X150S	0.56		0.68	ampere
Amplification Factor (Grid-to-Screen)		5		

Direct Interelectrode Capacitances, Grounded Cathode:*	Min.	Max.
Input	16.25	18.75 uuf
Output	4.0	4.8 uuf
Feedback		0.06 uuf
Frequency for Maximum Ratings		150 mc
Highest Useful Frequency		500 mc

*In Shielded Fixture

MECHANICAL

Base	JEDEC B8-236
Maximum Operating Temperatures:	
Base Seals	250° C
Anode Seal	200° C
Anode Core	250° C
Recommended Socket	Eimac SK-600 series
Operating Position	Any
Maximum Dimensions:	
Height	2.414 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

	Frequencies up to 150 Mc.				500 Mc.†
D-C Plate Voltage	500	1000	1500	2000	1250 volts
D-C Screen Voltage	250	250	250	250	250 volts
D-C Grid Voltage	—90	—90	—90	—90	—80 volts
D-C Plate Current	250	250	250	250	200 ma
D-C Screen Current*	45	38	21	19	7 ma
D-C Grid Current*	35	31	28	26	10 ma
Peak R-F Grid Voltage*	114	114	112	112	... volts
Driving Power	4.0	3.5	3.2	2.9	10 watts
Plate Input Power	125	250	375	500	250 watts
Plate Output Power	70	190	280	390	140 watts

*Approximate values.

†The typical performance figures for 500-megacycle operation were obtained by direct measurement in operating equipment. The output power is useful output power measured at the load. The driving power is the total power taken by the tube and a practical resonant circuit.

NOTE: Heater voltage was reduced to 5.5 volts and 24.3 volts for the 4X150R and 4X150S respectively.

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PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	1600 MAX. VOLTS
150 to 500 megacycles	1000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 megacycles)

D-C Plate Voltage	500	1000	1600 volts
D-C Screen Voltage	250	250	250 volts
D-C Grid Voltage	—150	—150	—150 volts
D-C Plate Current	200	200	200 ma
D-C Screen Current*	25	20	18 ma
D-C Grid Current*	23	21	21 ma
Peak R-F Grid Input Voltage*	173	172	172 volts
Driving Power	4.0	3.6	3.6 watts
Plate Input Power	100	200	320 watts
Plate Output Power	47	140	250 watts

*Approximate values.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (per tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	200	200	200 ma
Max-Signal D-C Plate Current	500	500	500 ma
Max-Signal D-C Screen Current	20	16	10 ma
Effective Load, Plate to Plate	3500	6200	9500 ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50 volts
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	240	430	600 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 Mc)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	100	100	100 ma
D-C Plate Current	150	150	150 ma
D-C Screen Current*	—3	—4	—4 ma
Peak R-F Grid Voltage*	25	25	25 volts
Plate Output Power	30	50	65 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER, SSB

Class-AB_1 (Single-Tone Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 megacycles)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Peak R-F Grid Voltage*	50	50	50 volts
Zero-Signal D-C Plate Current	100	100	100 ma
Single-Tone D-C Plate Current	250	250	250 ma
Two-Tone D-C Plate Current	190	190	190 ma
Single Tone D-C Screen Current*	10	8	5 ma
Two-Tone D-C Screen Current*	2	—1	—2 ma
R-F Load Impedance	1750	3100	4750 ohms
Single-Tone Plate Input Power	250	375	500 watts
Single-Tone Plate Output Power	120	215	300 watts

*Approximate values.

[1]Adjust to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

In class-C operation, adjustment of the r-f grid drive to obtain listed plate current at the listed grid bias, screen voltage, and plate voltage is assumed. Resultant screen and grid currents will vary from tube to tube, but little change in output power will be noted.

In class-AB_1 linear operation, screen current will also vary from tube to tube but is a useful indicator of relative linearity. In general, less screen current means better linearity, providing other conditions are held constant. The same degree of linearity will be obtained from different tubes if loading and drive are adjusted to give the same plate and screen currents, although output power may vary from tube to tube.

APPLICATION

MECHANICAL

Mounting—The 4X150R and 4X150S may be operated in any position. An Eimac Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

Cooling—Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the Eimac SK-600 series and an Eimac SK-606 chimney are used with air flow in the base to anode direction.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
200	5.0	0.52	7.3	0.76
250	6.4	0.82	9.3	1.20

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 Mc or below, base-cooling air requirements are satisfied automatically when the tube is operated in an Eimac Air-System Socket and the recommended air-flow rates are used. Experience has shown that if reliable long-life operation is to be obtained, the cooling air-flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Shock and Vibration—The 4X150R and 4X150S are two Eimac tube types unique in that shock and vibration testing are performed with *maximum rated plate and screen voltages* applied. Two samples of production tubes are randomly selected periodically and tested under the conditions outlined below.

With *maximum rated plate and screen voltages* applied, each of the tubes in this sample is subjected to six shocks of 90 G (minimum) half-sine-wave motion, with a duration of 11±2 milliseconds, in each of the three major axes (X1, X2, and Y1).

With *maximum rated plate and screen voltages* applied and with control-grid voltage adjusted to allow the flow of 100 ma through a plate load resistor of 4900 ohms, each of the tubes in this sample is vibrated in the three major axes throughout the range of 5-750-5 cps in a minimum time of six minutes per axis. The vibration level is maintained at 10 G from 28 cps to 750 cps and at 0.25 inch D.A. from 5 cps to 28 cps. During this test noise voltage developed across the plate load resistor cannot exceed 30 volts rms. Sufficient plate power-supply voltage (2500 volts) is employed to assure that a minimum of 2000 volts appears at the plate of the tube under test even though 490 volts drop across the plate load resistor results from d-c plate-current flow.

The equipment designer is cautioned to provide adequate tube support to prevent relative motion between tube and socket in equipments where shock and/or vibration are anticipated.

ELECTRICAL

Heater—The rated heater voltage for the 4X150R and 4X150S is 6.0 volts and 26.5 volts respectively, and the voltage should be maintained as closely as practicable. Short-time changes of + 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained with ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 megacycles, transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a "straight-through" class-C amplifier, the heater voltage should be reduced according to the table below:

Frequency, Mc	4X150R	4X150S
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode—The cathode of each type is connected to the four even-numbered base pins to provide a low-inductance path, or permit separation of input and output circuits if required.

Rated heater voltage should be applied before other operating voltages are applied.

Heater-to-cathode maximum voltage is ±150 volts.

Control-Grid—Maximum rated d-c bias voltage is −250 volts. D-C resistance, grid-to-cathode, should be no more than 100,000 ohms.

Screen-Grid—Maximum screen dissipation for each type is 12 watts, normally computed by multiplying d-c screen voltage by the average screen current. This computation is essentially correct except in the case of heavy plate loading when secondary-emission current may mask the normal screen current.

All tetrodes, under some conditions of loading and drive, will exhibit secondary emission from the screen which changes the net current to the screen and may even cause the screen current meter to reverse. Normally, secondary emission is harmless provided the screen voltage is stable. To insure stable screen voltage, it is recommended that a bleeder resistor calculated to pass 15 ma from screen to ground be used.

Plate Dissipation—The maximum plate dissipation for either type is 250 watts. The usual single-sideband voice signal is complex and full peak envelope power

shown in Typical Operating Conditions may be developed without exceeding this plate dissipation. Single-tone testing for short periods with greater than 250 watts plate dissipation is permissible.

Multiple Operation—To obtain maximum power with minimum distortion from tubes operated in multiple it is desirable to adjust individual screen or grid-bias voltages so the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual d-c plate currents will be approximately equal for full input signal for class-AB_1 operation.

Special Application—If it is desired to use the 4X150R or the 4X150S under conditions widely different from those given here, consult the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., San Carlos, California, or any of our regional offices or representatives.

PIN NO. 1. SCREEN GRID

PIN NO. 2. CATHODE

PIN NO. 3. HEATER

PIN NO. 4. CATHODE

PIN NO. 5. I.C. DO NOT USE FOR EXTERNAL CONNECTION

PIN NO. 6. CATHODE

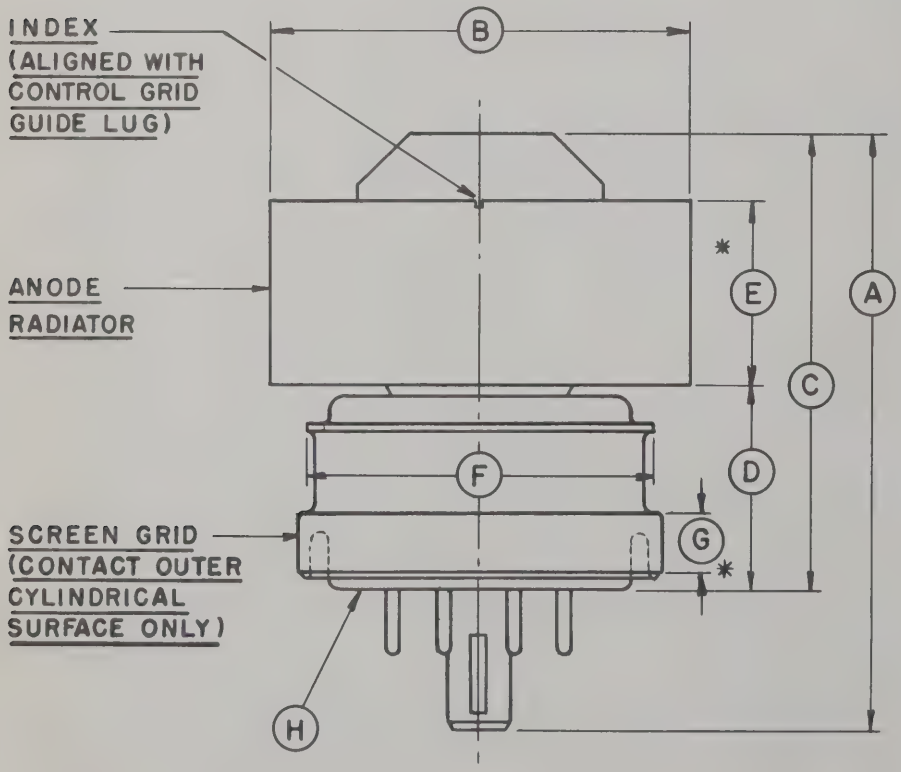
PIN NO. 7. HEATER

PIN NO. 8. CATHODE

CENTER PIN – CONTROL GRID

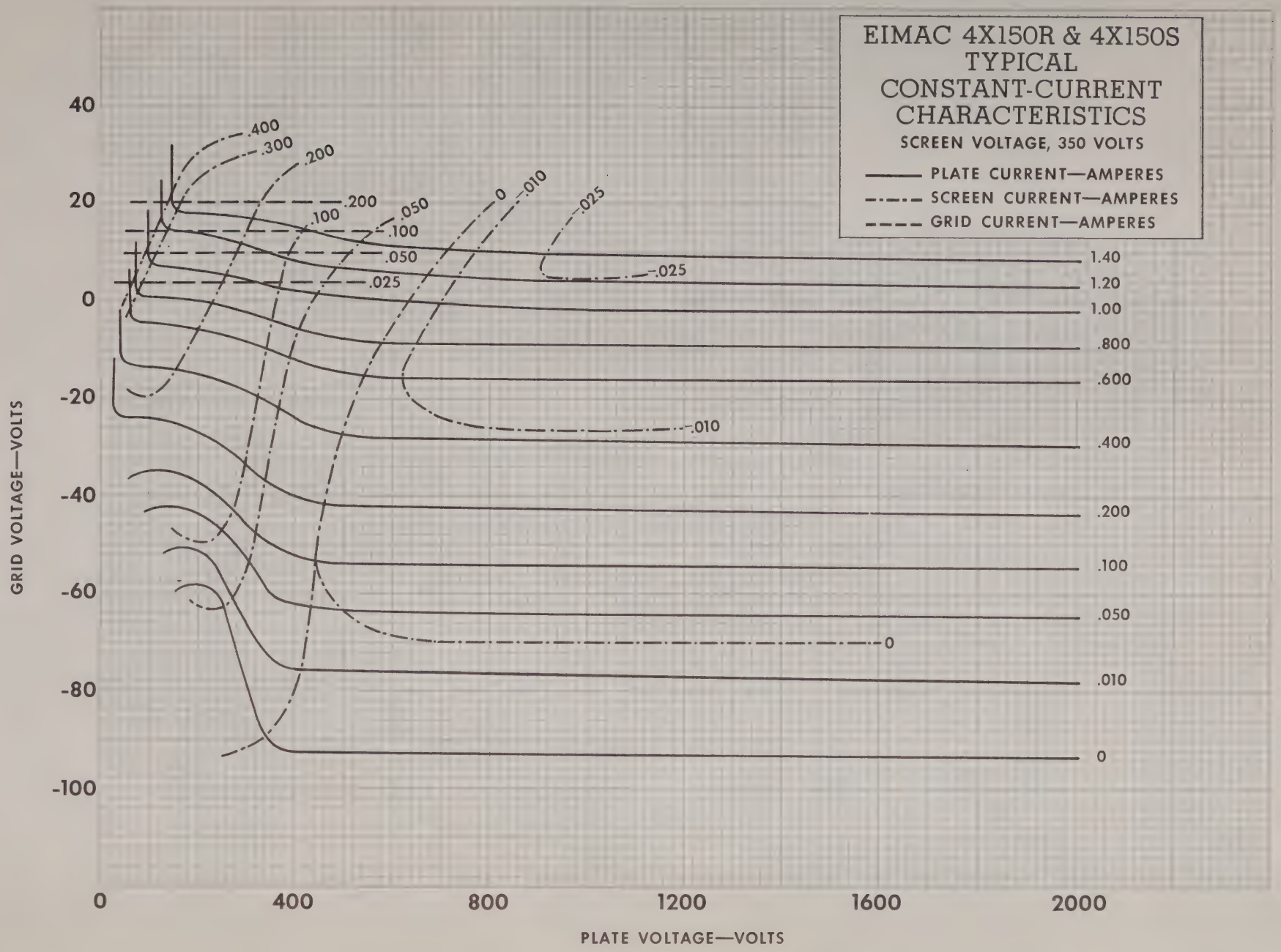
DIMENSIONS IN INCHES

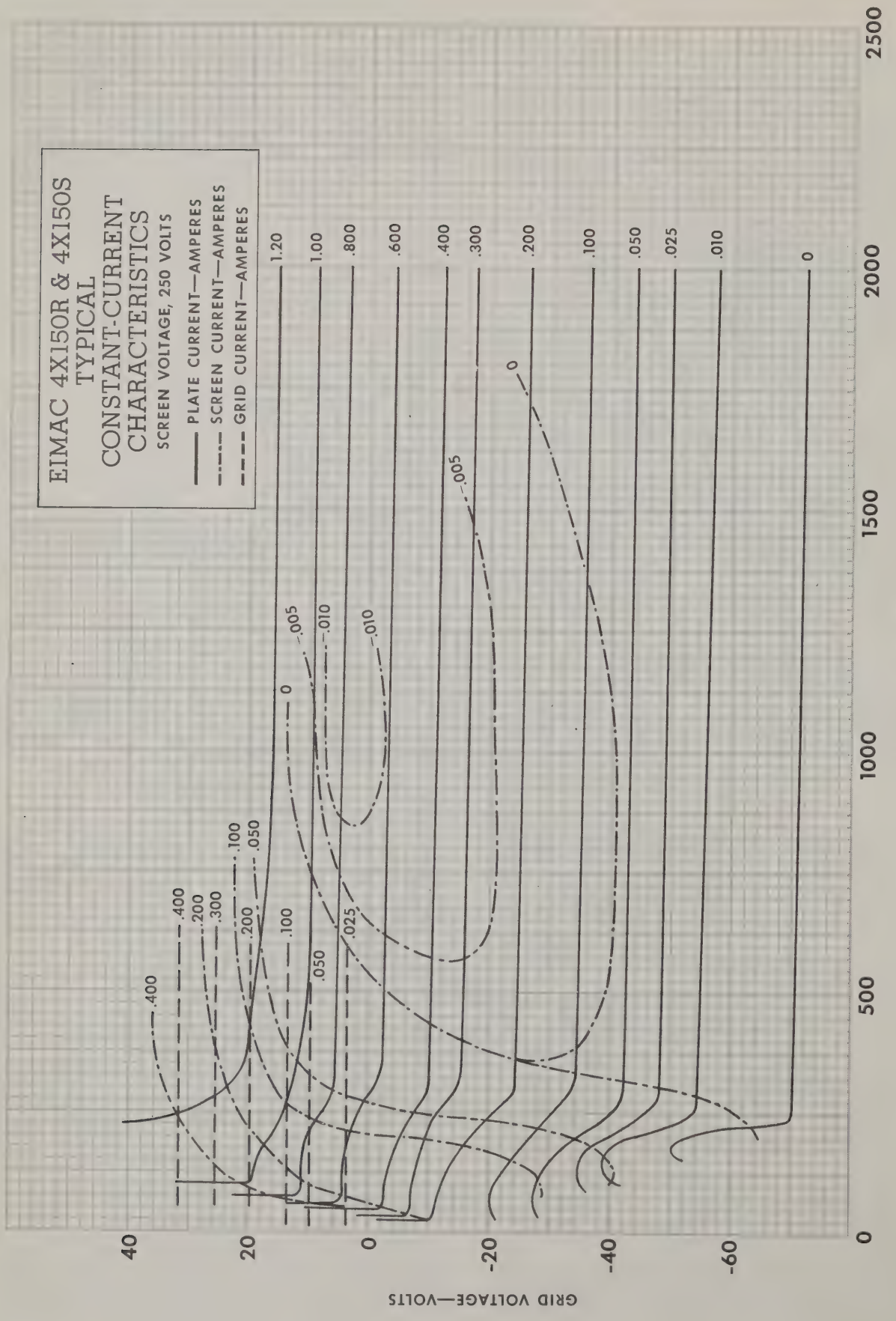
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	2.224	2.414	
B	1.610	1.640	
C	1.710	1.860	
D	.750	.810	
E	.710	.790	
F		1.406	
G	.187		
H	BASE : B8-236 (JEDEC DESIGNATION)		



DIMENSIONS IN INCHES

* CONTACT SURFACE


EIMAC 4X150R & 4X150S
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.400
.300
.200
.200
.100
.050
.025
0
.010
.025
.025
.010
0


EIMAC 4X150R & 4X150S
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 250 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
GRID VOLTAGE—VOLTS
40
20
0
-20
-40
-60
PLATE VOLTAGE—VOLTS
0
500
1000
1500
2000
2500

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

4X250B

RADIAL-BEAM POWER TETRODE

The 4X250B is a compact, forced-air cooled, external-anode radial-beam tetrode with a maximum plate dissipation rating of 250 watts. The 4X250B is capable of producing 390 watts of output power at frequencies up to 175 megacycles, and at the maximum rated frequency of 500 megacycles a minimum of 225 watts may be obtained.

The 4X250B has low driving-power requirements and is capable of producing up to 70 watts of output power with a plate supply of 500 volts, making it an excellent choice for mobile applications.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-heater Potential	-	-	±150	volts
Heater: Voltage, 4X250B	-	6.0		volts
Current, 4X250B	2.3		2.9	amperes
Amplification Factor (Grid-to-Screen)	4.4		6.0	
Transconductance (I_b = 200 ma)	-	12,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	14.2		17.2	uuf
Output	4.0		5.0	uuf
Feedback	-	-	0.06	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Nom.	Max.	
Input	-	13.0		uuf
Output	4.0		5.0	uuf
Feedback	-	0.01		uuf
Frequency for Maximum Ratings	-	-	500	mc

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175° C
Ceramic-to-Metal Seals	250° C
Anode Core	250° C
Recommended Socket	Eimac SK-600 Series
Operating Position	Any
Maximum Dimensions:	
▶ Height	2.464 inches
▶ Seated Height	1.910 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

	Frequencies up to 175Mc				500Mc	
D-C Plate Voltage	500	1000	1500	2000	2000	volts
D-C Screen Voltage	250	250	250	250	300	volts
D-C Grid Voltage	—90	—90	—90	—90	—90	volts
D-C Plate Current	250	250	250	250	250	ma
D-C Screen Current*	45	38	21	19	10**	ma
D-C Grid Current*	35	31	28	26	25**	ma
Peak R-F Grid Voltage*	114	114	112	112	—	volts
Driving Power*	4.0	3.5	3.2	2.9	—	watts
Plate Input Power	125	250	375	500	500	watts
Plate Output Power	70	190	280	390	225**	watts
Heater Voltage	6.0	6.0	6.0	6.0	5.5	volts

*Approximate values.
**Measured values for a typical cavity amplifier circuit.

(Effective 1-1-60) Copyright 1960 by Eitel-McCullough, Inc.

▶ Indicates change from sheet dated 8-18-58

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc)

D-C Plate Voltage	500	1000	1500 volts
D-C Screen Voltage	250	250	250 volts
D-C Grid Voltage	—100	—100	—100 volts
D-C Plate Current	200	200	200 ma
D-C Screen Current*	31	22	20 ma
D-C Grid Current*	15	14	14 ma
Peak R-F Grid Input Voltage*	118	117	117 volts
Driving Power*	1.8	1.7	1.7 watts
Plate Input Power	100	200	300 watts
Plate Output Power	60	145	235 watts

*Approximate values.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	200	200	200 ma
Max-Signal D-C Plate Current	500	500	500 ma
Max-Signal D-C Screen Current	20	16	10 ma
Effective Load, Plate to Plate	3500	6200	9500 ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50 volts
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	240	430	600 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	100	100	100 ma
D-C Plate Current	150	150	150 ma
D-C Screen Current*	—3	—4	—4 ma
Peak R-F Grid Voltage*	25	25	25 volts
Plate Output Power	30	50	65 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc, peak-envelope conditions except where noted)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	100	100	100 ma
Peak R-F Grid Voltage*	50	50	50 volts
D-C Plate Current	250	250	250 ma
D-C Screen Current*	10	8	5 ma
Plate Input Power	250	375	500 watts
Plate Output Power	120	215	300 watts
Two-Tone Average D-C Plate Current	190	190	190 ma
Two-Tone Average D-C Screen Current*	2	—1	—2 ma

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4X250B may be operated in any position. An Eimac Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen by-pass capacitors and may be obtained with either grounded or ungrounded cathode terminals.

The tube will fit in a standard Loktal socket, but use of the Loktal socket is *not* recommended. The use of a Locktal socket in the usual way does not provide for cooling the base of the tube.

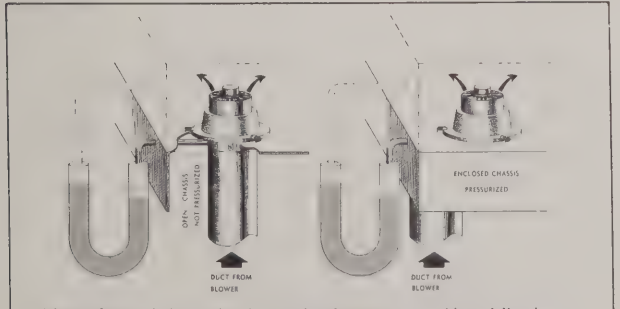
▶ **Cooling**—Sufficient cooling must be provided for the anode, base seals and body seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	250°C
Glass-to-Metal Seals	175°C
Anode Core	250°C

Air requirements to maintain seal temperatures at 175°C in 50°C ambient air are tabulated below. These requirements apply when the Eimac SK-600 or SK-610 socket is used with air flow in the *base to anode* direction.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
200	3.8	0.28	5.5	0.40
250	5.6	0.53	8.1	0.77

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.



When exhaust air is restricted by a closed compartment (dotted lines), manometer return must be made to the compartment, not to free atmosphere.

METHODS OF MEASURING PRESSURE DIFFERENTIAL

At 500 Mc. or below, base-cooling air requirements are satisfied automatically when the tube is operated in an Eimac Air-System Socket and the recommended air-flow rates are used. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt, which might interfere with effective cooling.

If cooling methods other than forced air are used, if the recommended air-flow rates are not supplied or if there is any doubt that the cooling is adequate, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. One method of measuring the surface temperatures is by the use of a temperature-sensitive lacquer. When temperature-sensitive materials are used, extremely thin applications must be used to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

Vibration—These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration are expected to exceed approximately 5g units, it is suggested that the Eimac 4CX300A be employed.

ELECTRICAL

Heater—The rated heater voltage for the 4X250B is 6.0 volts and this voltage should be maintained as closely as practicable. Short-time variations of the voltage of ±10% of the rated value will not damage the tube, but variations in performance must be expected. The heater voltage should be maintained within ±5% of its rated value to minimize variations in performance and to obtain maximum tube life.

At frequencies above approximately 300 megacycles transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon the frequency, the plate current, and driving power being supplied to the tube. When the tube is driven to maximum input as a "straight-through" class-C amplifier, the heater voltage should be reduced according to the table below:

Freqency, Mc.	4X250B
300 and lower	6.0 volts
301 to 400	5.75 volts
401 to 500	5.50 volts

In no case should the heater of the 4X250B be operated at less than 5.4 volts.

Cathode Operation—The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum rated d-c input current is 200 milliamperes for plate-modulated operation, and 250 milliamperes for all other types of operation except pulsed.

Higher cathode currents are permitted in pulsed operation and the maximum permissible pulse currents will depend entirely on the pulse lengths and the pulse repetition rates. The maximum rated pulse plate current of 6.0 amperes may be used only when the pulses do not exceed five microseconds in duration, and when the repetition rate does not exceed 1000 pulses per second. The curve of Fig. 2 shows the maximum permissible pulse currents and pulse durations for repetition rates of 1000 pps or less. For higher repetition rates the indicated pulse durations must be shortened by the factor 1000/n, where n is the number of pulses per second.

▶ Indicates change from sheet dated 1-3-58

The cathode is internally connected to the four even-numbered base pins, and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Control-Grid Operation— The maximum rated d-c grid bias voltage is −250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rated power. At operating frequencies above the 100-megacycle region, driving-power requirements for amplifiers increase noticeably until at 500 megacycles as much as 30 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than the grid dissipation, so that the grid dissipation is only slightly increased. Satisfactory 500-megacycle operation of the tubes in a stable, "straight-through" amplifier is indicated by grid-current values below approximately 25 milliamperes.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

Screen-Grid Operation—The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated d-c screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the d-c screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the d-c screen voltage and the peak a-c or r-f signal voltage applied to screen or cathode.

Protection for the screen can be provided by an over-current relay and by interlocking the screen supply so that the plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions, and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind, so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using this tube may not be satisfactory because of the screen−voltage−screen−current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a separate small modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation of plate-modulated r-f amplifiers using the 4X250B

Plate Operation—The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate-dissipation rating with 100% sine-wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

At frequencies up to approximately 30 megacycles the top cap on the anode cooler may be used for a plate terminal. At higher frequencies, a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler should be used.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize the inputs.

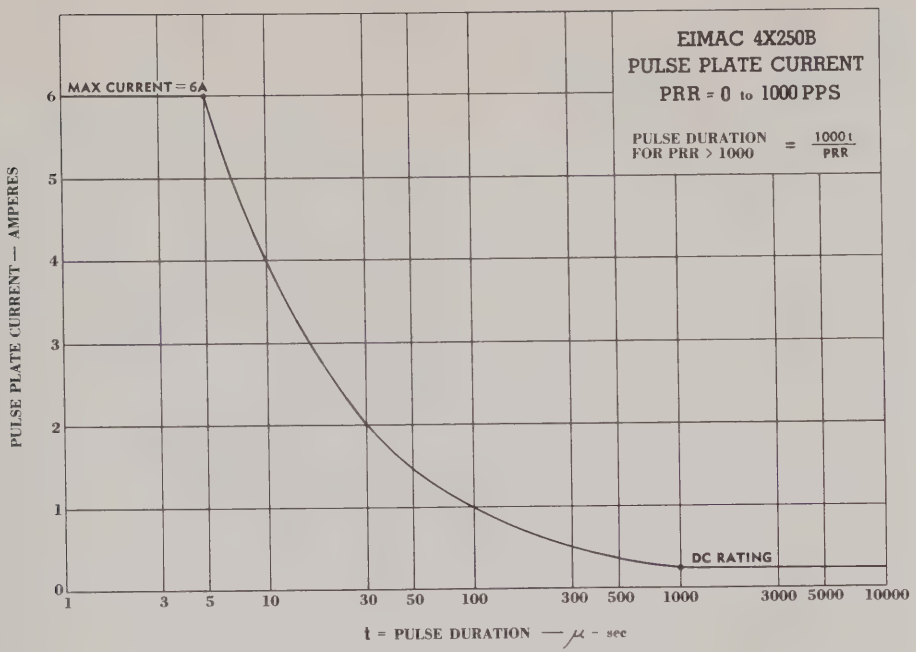
Where overload protection is provided, it should be capable of protecting the surviving tube/s in the event that one tube should fail.

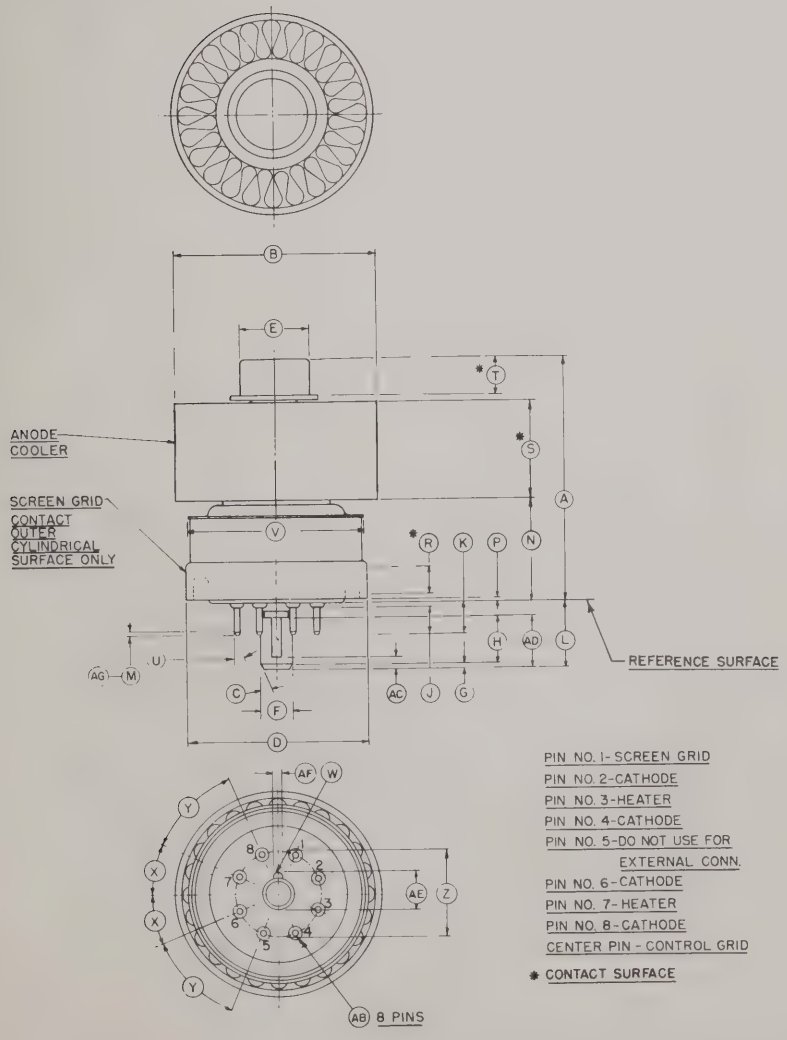
UHF Operation—The 4X250B is useful in the UHF region. UHF operation should be conducted with heavy plate loading, minimum bias and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

Some of the added circuit loss observed in UHF operation is in the base insulator of the tube. It is sometimes necessary to use more than the recommended minimum air-flow rates to maintain safe operating base temperatures at UHF.

These tubes may be used in frequency multiplier applications. Such operation results in low plate efficiency and requires high driving voltages. If the frequency multiplier is used as an output power stage, it is preferable to operate the final tube as a frequency doubler rather than a frequency tripler.

Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

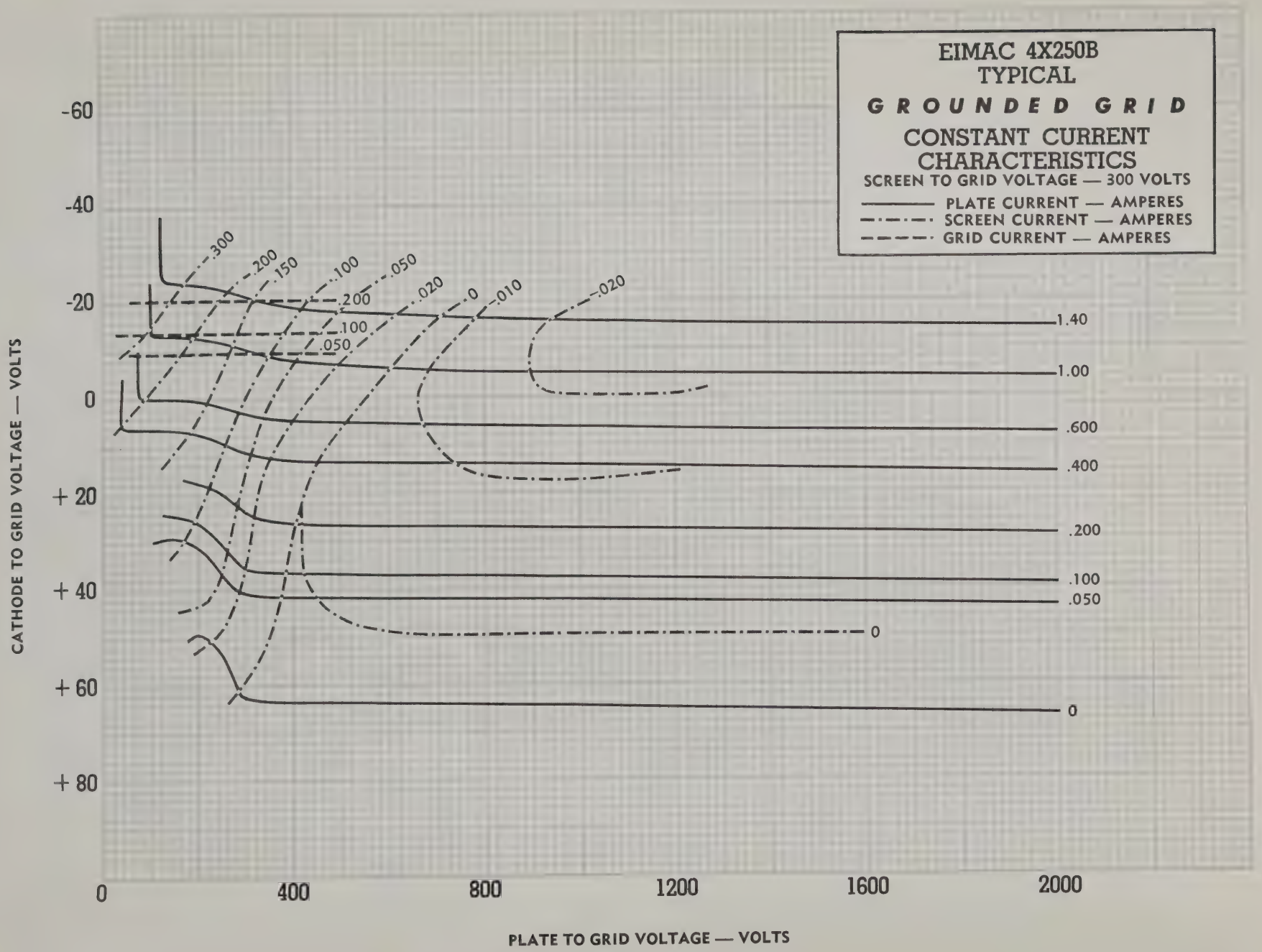


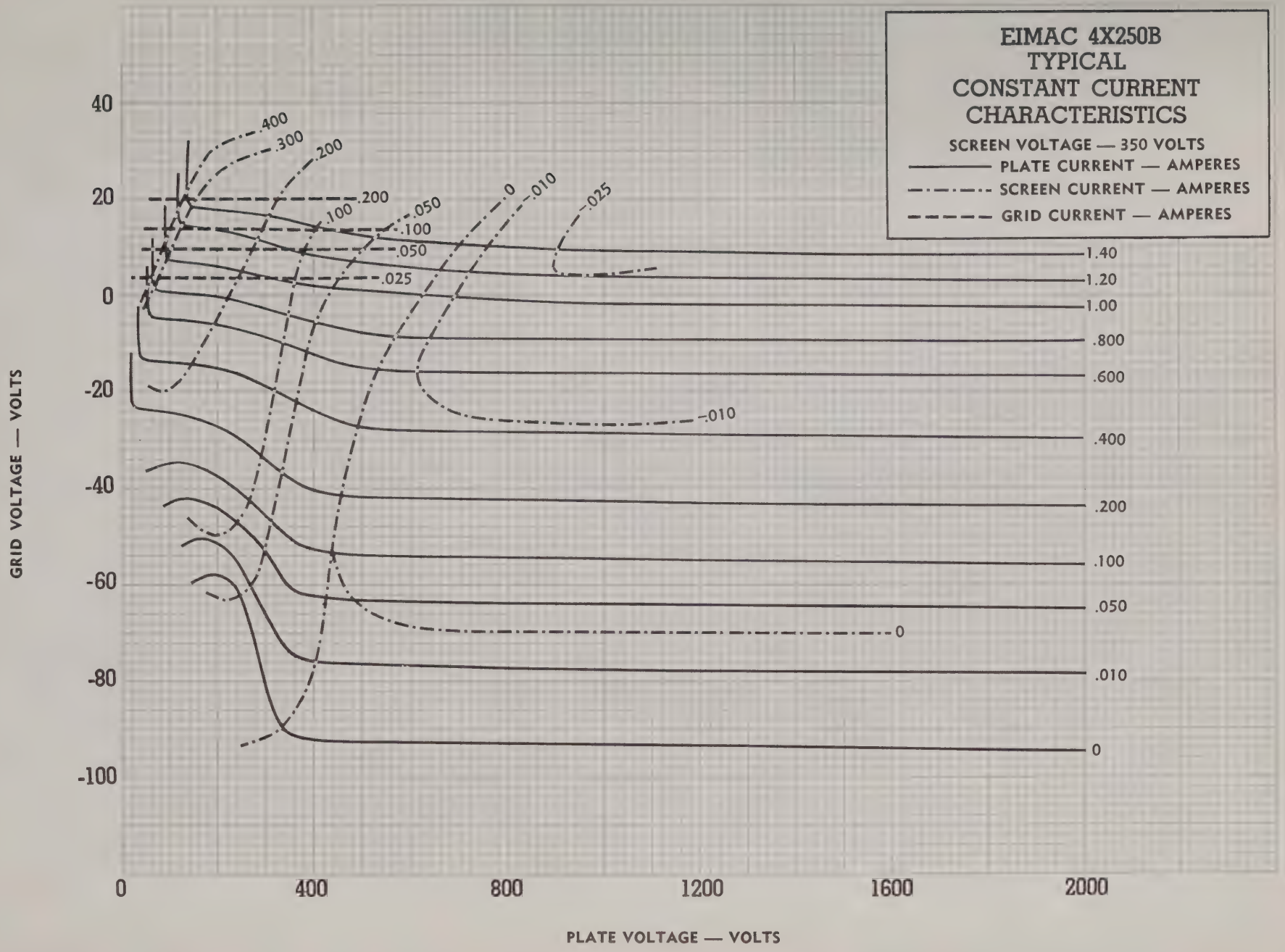


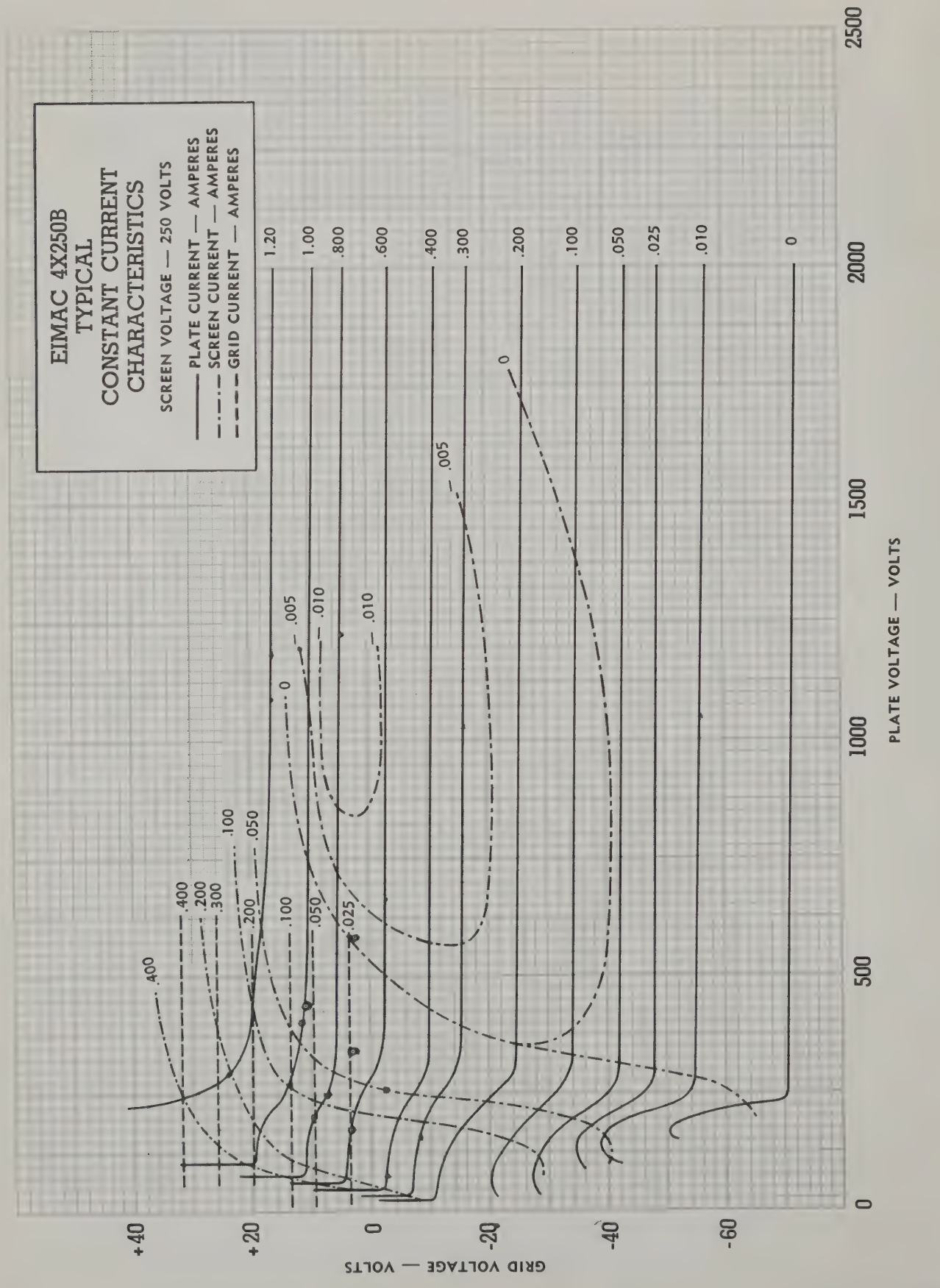
PIN NO. 1 - SCREEN GRID
PIN NO. 2 - CATHODE
PIN NO. 3 - HEATER
PIN NO. 4 - CATHODE
PIN NO. 5 - DO NOT USE FOR EXTERNAL CONN.
PIN NO. 6 - CATHODE
PIN NO. 7 - HEATER
PIN NO. 8 - CATHODE
CENTER PIN - CONTROL GRID

* CONTACT SURFACE

DIMENSIONS IN INCHES		
REF.	MIN.	MAX.
A	1.810	1.910
B	1.610 DIA.	1.640 DIA.
C	30°	
D	1.417 DIA.	1.433 DIA.
E	.559 DIA.	.573 DIA.
F	.255 DIA.	.265 DIA.
G	.031	
H	.360	
J	.187	
K		.250
L	.514	.554
M	.035	
N	.750	.810
P	.020	
R	.187	
S	.710	.790
T	.240	.280
U	22 1/2°	
V		1.406 DIA.
W		.043 R.
X	22 1/2°	
Y	45°	
Z	.680 DIA. P.C.	.694 DIA. P.C.
AB	.045 DIA.	.053 DIA.
AC	.068	.108
AD		.456
AE	.298	.308
AF	.078	.086
AG	.005 R. MIN. (ALTERNATE TO M&U)	


EIMAC 4X250B
TYPICAL
GROUNDED GRID
CONSTANT CURRENT
CHARACTERISTICS
SCREEN TO GRID VOLTAGE — 300 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
CATHODE TO GRID VOLTAGE — VOLTS
-60
-40
-20
0
+ 20
+ 40
+ 60
+ 80
0
400
800
1200
1600
2000
PLATE TO GRID VOLTAGE — VOLTS
.300
.200
.150
.100
.050
.020
0
-.010
-.020
.200
.100
.050
1.40
1.00
.600
.400
.200
.100
.050
0
0


EIMAC 4X250B
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 350 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
.400
.300
.200
.200
.100
.050
.025
.100
.050
.025
0
.010
.025
.010
0
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0



Printed in U.S.A. 83457

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

4X500A

RADIAL-BEAM POWER TETRODE



The Eimac 4X500A is an external-anode tetrode having a maximum plate dissipation rating of 500 watts. Its small size and low-inductance leads permit efficient operation at relatively large outputs well into the VHF region. The screen grid is mounted on a disc which terminates in a connector ring located between grid and plate, thus making possible effective shielding between the grid and plate circuits. The grid terminal is located at the center of the glass base to facilitate single-tube operation in coaxial circuits.

The combination of low grid-plate capacitance, low screen-lead inductance and functionally located terminals contributes to the stable operation of the 4X500A at high frequencies, making neutralization unnecessary in most cases and greatly simplifying it in others.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		5		volts
Current	12.2		13.7	amperes
Amplification Factor (Grid-to-Screen)	4.5		6.5	
Transconductance (I_b = 200 ma., E_b = 2500v., E_{c2} = 500v.)		5200		umhos
Direct Interelectrode Capacitances Grounded Cathode:				
Input	10.5		14.4	uuf
Output	4.9		6.9	uuf
Feedback			0.1	uuf
Frequency for Maximum Ratings			120	mc.

MECHANICAL

Base	Special 4 pin
Maximum Operating Temperatures:	
Glass-to-Metal Seals	150° C
Anode Core	150° C
Recommended Socket	Eimac SK900
Operating Position	Vertical, base up or down
Maximum Dimension:	
Height	4.75 inches
Diameter	2.625 inches
Cooling (See following page)	Forced Air
Net Weight	1.7 pounds
Shipping Weight (Approximate)	6 pounds

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C FM or Telegraphy (Key-down conditions, 1 tube)
MAXIMUM RATINGS (Frequencies up to 120 Mc.)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA.
PLATE DISSIPATION	500 MAX. WATTS
SCREEN DISSIPATION	30 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Per tube, at 110 Mc.)

D-C Plate Voltage	2500	3000	4000	Volts
D-C Plate Current	310	310	315	Ma.
D-C Screen Voltage	500	500	500	Volts
D-C Screen Current	26	24	22	Ma.
D-C Grid Voltage	—150	—150	—150	Volts
D-C Grid Current	15	16	16	Ma.
Driving Power (approx.)	5	5	5	Watts
Useful Power Output (approx.)	475	600	835	Watts

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RADIO FREQUENCY POWER AMPLIFIER

Class-B Linear Amplifier,

Television Visual Service

MAXIMUM RATINGS (Frequencies below 220 mc.)

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA.
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
PLATE DISSIPATION	500 MAX. WATTS
SCREEN DISSIPATION	30 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION

(Per tube at peak synchronizing level, 5-Mc. bandwidth, assumed load resistance 3,000 ohms per tube.)[1]

D-C Plate Voltage	1850	2400	Volts
D-C Screen Voltage	500	500	Volts
D-C Grid Voltage	—100	—100	Volts
D-C Plate Current	285	400[1]	Ma.
D-C Screen Current (approx.)	20	35	Ma.
D-C Grid Current (approx.)	10	15	Ma.
Peak R-F Grid Voltage	140	185	Volts
Driving Power, 220 Mc. (approx.)	15	25	Watts
Plate Power Input	525	960	Watts
Power Output	300	600	Watts
BLACK LEVEL			
D-C Plate Current	215	300	Ma.
D-C Screen Current	2	3	Ma.
D-C Grid Current	2	5	Ma.
Plate Power Input	400	720	Watts
Plate Dissipation	230	380	Watts
Power Output	170	340	Watts

[1] Operating conditions at peak synchronizing level may be permitted to exceed maximum ratings of the tube because of the low duty factor. Maximum ratings apply to black level conditions.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

APPLICATION

MECHANICAL

Mounting—The 4X500A must be operated vertically. The base may be down or up. The recommended socket for this tube is the SK-900 Air-System Socket.

Cooling—Forced-air cooling must be provided to hold the glass-to-metal seals and the anode cooler core below the maximum rated temperature of 150°C.

A flow rate of 20 cfm will be adequate for operation at sea level and with an inlet air temperature up to 50°C. Under these conditions, 20 cfm of air flow corresponds to a pressure difference across the tube and SK-900 socket of 2.25 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes increased air flow will be required. For example, at an altitude of 10,000 feet, a flow-rate of 29 cfm will be required and will be obtained with a pressure drop across tube and socket of 3.25 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and at the particular altitude.

The pressure drop figures indicated above are those measured directly at the air gage hole in the SK-900 air system socket. In the event that a socket is not used, and a plenum pressure drop measurement is required, this plenum pressure drop rating must equal the pressure drop figures indicated above multiplied by 1.5 for the specific application.

ELECTRICAL

Filament Operation—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 5.0 volts. Variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Control Grid Operation—The d-c voltage for the 4X500A should not exceed 500 volts. If grid leak bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 Mc., it is advisable to keep the bias voltage as low as is practicable.

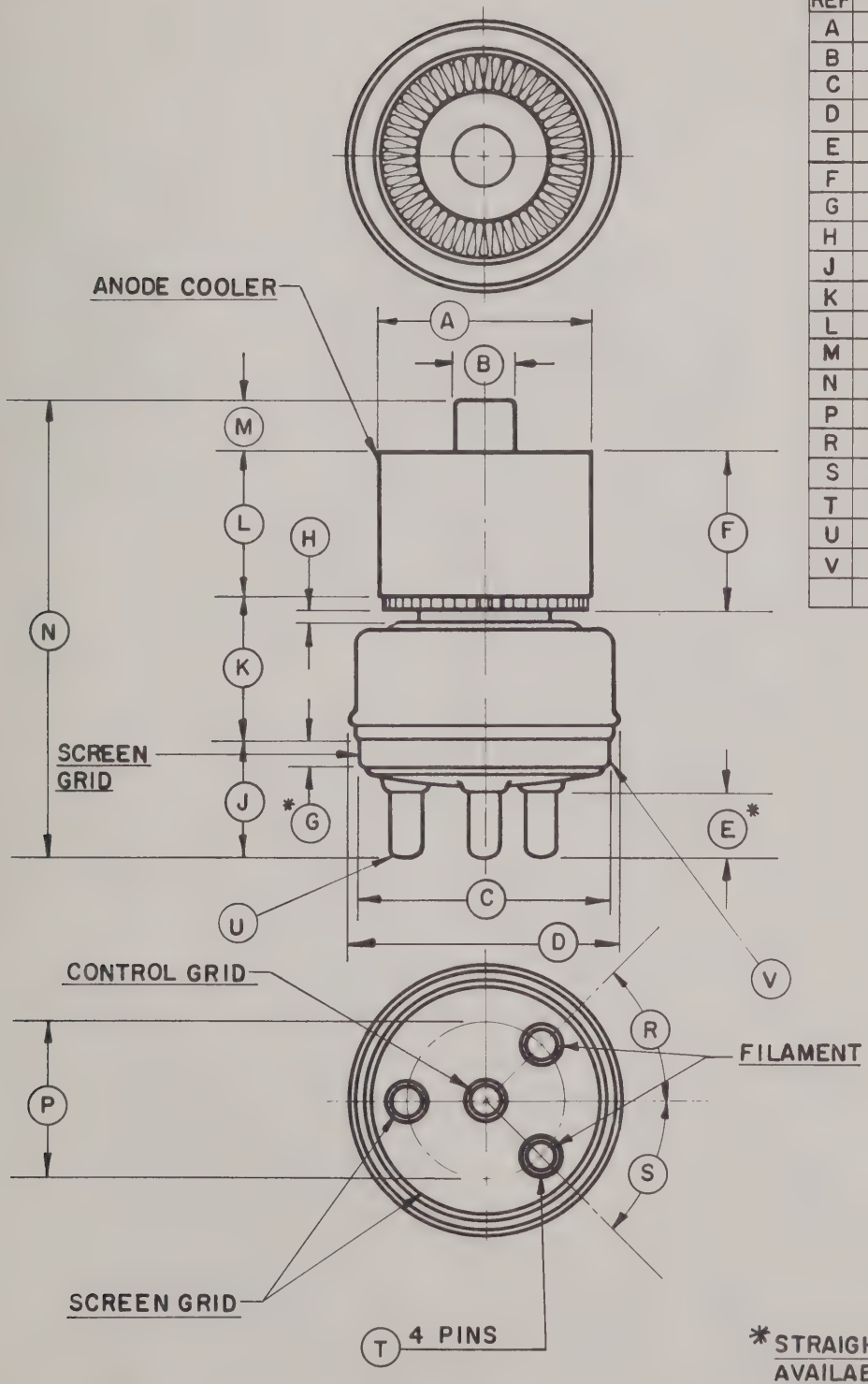
Screen Grid Operation—Power dissipated by the screen of the 4X500A must not exceed 30 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 30 watts in event of circuit failure.

Plate Operation—The maximum rated plate-dissipation power is 500 watts. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize the inputs.

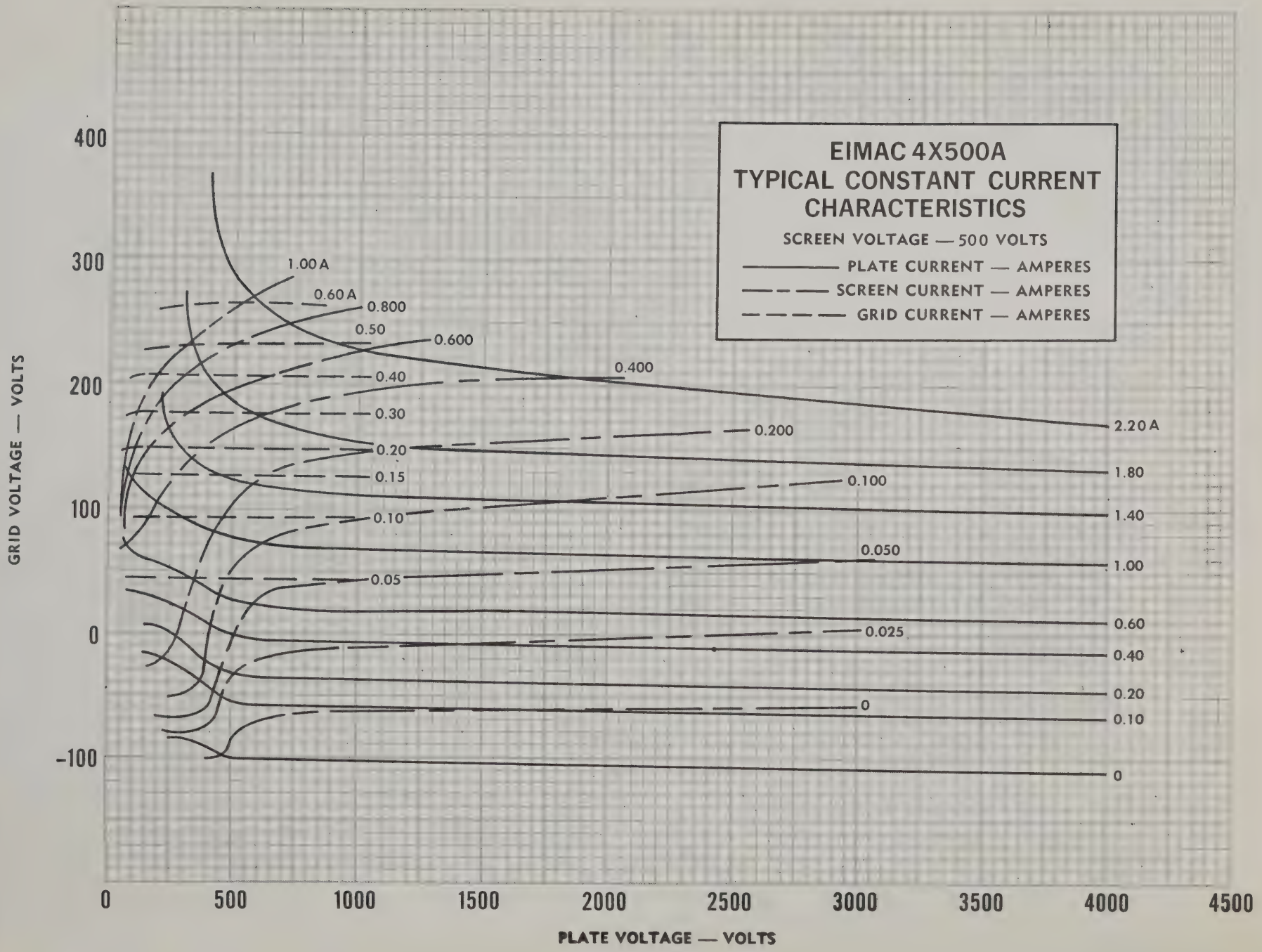
Where overload protection is provided, it should be capable of protecting the surviving tube/s in the event that one tube should fail.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.



DIMENSIONS IN INCHES		
REF	MIN.	MAX.
A	1.980	2.020
B	.559	.573
C	2.365	2.385
D		2.625
E	.500	
F	1.438	1.562
G	.156	
H	.062	
J	1	1.125
K	1.406	1.594
L	1.344	1.406
M	.438	.562
N	4.250	4.750
P	1.490	1.510
R	44°	46°
S	44°	46°
T	.308	.318
U	.031R	
V	.094R	

*STRAIGHT SIDE AVAILABLE FOR CONTACT



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TECHNICAL DATA

6816
6884
7843

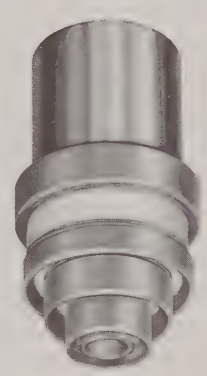
RADIAL-BEAM
POWER TETRODES

The EIMAC 6816, 6884, and 7843 are compact external anode ceramic/metal radial-beam tetrodes for use in rf power amplifier or oscillator service, linear rf power amplifier applications, and as audio amplifiers or modulators. The 6816 has a 6.3 volt heater, while the 6884 has a 26.5 volt heater, and both are designed for transverse-flow forced-air cooling of the anode. The 7843 has a 26.5 volt heater and its anode is designed for conduction cooling.

All three types have an F1 rating of 1215 MHz for full-rated power input, and are tested to give a useful power output of 80 watts at 400 MHz and 40 watts at 1200 MHz.



6816/6884



7843

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated Unipotential

Heater Voltage (6816)	6.3 ± 10%	V
Heater Current (at 6.3 V)	2.0	A
Heater Voltage (6884, 7843)	26.5 ± 10%	V
Heater Current (at 26.5 V)	0.53	A
Amplification Factor (Average):		
Grid to screen	18	
Direct Interelectrode Capacitances [2]		
Control Grid to Cathode	13.0	pF
Control Grid to Screen Grid	17.5	pF
Screen Grid to Anode	4.7	pF
Control Grid to Anode	0.05	pF
Anode to Cathode	0.01	pF
Screen Grid to Cathode	0.33	pF

1. Characteristics and operating values are based on performance tests. These figures may change without notice as a result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association Standard RS-191.

MECHANICAL

Maximum Overall Dimensions:	6816 & 6884	7843
Length	1.930 In; 49.02 mm	1.955 In; 49.66 mm
Diameter	1.265 In; 32.13 mm	1.120 In; 28.45 mm
Net Weight	2.0 oz; 56.7 gm	1.7 oz; 48.2 gm
Operating Position	Any	Any

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Cooling:
- Type 6816, 6884 ..... Forced Air
- Type 7843 ..... Conduction Cooled

Operating Temperature, Maximum, all three types:
- Ceramic/Metal Seals and Anode Core ..... 250°C

Base (all types) ..... Special Coaxial

Recommended Sockets (Screen Grid bypass capacitor included): Erie 2948-000
E.F. Johnson 124-152-1
Jettron 89-001

Recommended Screen Grid bypass capacitor (separate unit): ..... Erie 2929-001

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current (Type 6816, at 6.3 volts)	1.84	2.26	V
(Type 6884, 7843, at 26.5 volts)	0.48	0.60	A
Cathode Warmup Time (all types)	60	---	Sec
Interelectrode Capacitances [1]			
Control Grid to Cathode	11.0	15.0	pF
Control Grid to Screen Grid	15.0	20.0	pF
Screen Grid to Anode	4.2	5.2	pF
Control Grid to Anode	---	0.065	pF
Anode to Cathode	---	0.013	pF
Screen Grid to Cathode	0.20	0.45	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association Standard RS-191.

RADIO FREQUENCY LINEAR AMPLIFIER

Grid-driven, Class AB1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	1000	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT [1]	.180	AMPERE
PLATE DISSIPATION [2]	115	WATTS
SCREEN DISSIPATION	4.5	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz) Class AB1 Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	650	850	Vdc
Screen Voltage	300	300	Vdc
Grid Voltage [3]	-18	-18	Vdc
Zero Signal Plate Current	40	40	mAdc
Single-Tone Plate Current	100	100	mAdc
Two-Tone Plate Current	75	75	mAdc
Single-Tone Screen Current [4]	8	4	mAdc
Two-Tone Screen Current [4]	3.5	2	mAdc
Resonant Load Impedance	2200	3500	Ω
Useful Power Output [5] PEP	25	40	W
Distortion Products [6] 3rd:	-35	-30	dB
5th:	-40	-35	dB

1. The maximum rating for a signal having a minimum peak-to-average power ratio less than 2.0, such as single-tone operation, is 180 mAdc. During short periods of circuit adjustment under single-tone conditions, the average anode current may reach the level of 250 mAdc.
2. With proper cooling for Types 6816 and 6884 and with adequate heat sink for Type 7843.
3. Adjust for the specified zero-signal plate current.
4. Approximate value.
5. Approximate value delivered to the load.
6. Referenced against one tone of a two equal-tone signal.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM Telephony
(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	1000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-100 VOLTS
DC PLATE CURRENT	0.180 AMPERE
PLATE DISSIPATION [1]	115 WATTS
SCREEN DISSIPATION	4.5 WATTS
GRID DISSIPATION	1.0 WATT

TYPICAL OPERATION

	400 MHz	1200 MHz	
Plate Voltage	400	900	900 Vdc
Screen Voltage	200	300	300 Vdc
Grid Voltage	-35	-30	-22 Vdc
Plate Current	150	170	170 mAdc
Screen Current [2]	5	1	1 mAdc
Grid Current [2]	3	10	4 mAdc
Driving Power [2]	3	3	5 W
Useful Power Output [3]	23	80	40 W

1. With proper cooling for Types 6816 and 6884 and with adequate heat sink for Type 7843.
2. Approximate value.
3. Approximate power delivered to the load.

PLATE MODULATED POWER AMPLIFIER
Class C Telephony
(Key-Down Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	800 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-100 VOLTS
DC PLATE CURRENT	0.150 AMPERE
PLATE DISSIPATION [1]	75 WATTS
SCREEN DISSIPATION	4.5 WATTS
GRID DISSIPATION	1.0 WATT

TYPICAL OPERATION AT 400 MHz

Plate Voltage	400	700 Vdc
Screen Voltage	200	250 Vdc
Grid Voltage	-20	-50 Vdc
Plate Current	100	130 mAdc
Screen Current [2]	5	10 mAdc
Grid Current [2]	5	10 mAdc
Peak Screen Voltage [2] (100% modulation)	150	150 v
Driving Power [2]	2	3 W
Useful Power Output [3]	16	45 W

1. With proper cooling for Types 6816 and 6884 and with adequate heat sink for Type 7843.
2. Approximate value.
3. Approximate power delivered to the load.

AUDIO FREQUENCY POWER AMPLIFIER & MODULATOR Grid-driven, Class AB 1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	1000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC PLATE CURRENT	0.180 AMPERE
PLATE DISSIPATION [1]	115 WATTS
SCREEN DISSIPATION	4.5 WATTS

1. With proper cooling for Types 6816 and 6884 and with adequate heat sink for Type 7843.
2. Adjust for specified zero signal plate current.
3. Approximate value.

TYPICAL OPERATION, Class AB 1
Values are for 2 tubes

Plate Voltage	650	850 Vdc
Screen Voltage	300	300 Vdc
Grid Voltage [2]	-15	-15 Vdc
Peak Drive Voltage, grid-to-grid	30	30 v
Zero Signal Plate Current	80	80 mAdc
Maximum Signal Plate Current	200	200 mAdc
Zero Signal Screen Current [3]	0	0 mAdc
Maximum Signal Screen Current [3]	20	20 mAdc
Effective Load Resistance (plate to plate)	4330	7000 Ω
Maximum Signal Power Output [3]	50	80 W

AUDIO FREQUENCY POWER AMPLIFIER & MODULATOR Grid-driven, Class AB 2

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	1000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC PLATE CURRENT	0.180 AMPERE
DC GRID CURRENT	0.030 AMPERE
PLATE DISSIPATION [1]	115 WATTS
SCREEN DISSIPATION	4.5 WATTS
GRID DISSIPATION	1.0 WATT

1. With proper cooling for Types 6816 and 6884 and with adequate heat sink for type 7843.
2. Adjust for specified zero signal plate current.
3. Approximate value.

TYPICAL OPERATION, Class AB 2
Values are for 2 tubes

Plate Voltage	650	850 Vdc
Screen Voltage	300	300 Vdc
Grid Voltage [2]	-15	-15 Vdc
Peak Drive Voltage, grid-to-grid	46	46 v
Zero Signal Plate Current	80	80 mAdc
Maximum Signal Plate Current	355	355 mAdc
Zero Signal Screen Current [3]	0	0 mAdc
Maximum Signal Screen Current [3]	25	25 mAdc
Maximum Signal Grid Current [3]	15	15 mAdc
Effective Load Resistance (plate to plate)	2450	3960 Ω
Driving Power [3]	0.3	0.3 W
Maximum Signal Power Output [3]	85	140 W

APPLICATION

ELECTRICAL

HEATER/CATHODE OPERATION - The rated heater voltage for the 6884 and the 7843 is 26.5 volts, and for the 6816, 6.3 volts, as measured at the base of the tube. Variations must be restricted to plus or minus ten percent, and where long life and consistent performance are factors, variation from the nominal value should be held to plus or minus five percent.

Because the cathode is subjected to considerable back bombardment (transit-time heating) as the frequency is increased, with resultant increase in cathode temperature, the heater voltage should be reduced in some applications, depending on operating conditions and frequency, to prevent overheating of the cathode and resultant short tube life.

ANODE CURRENT - The 6816, 6884, and 7843 are rated for 180 mAdc of continuous anode current. During short periods of circuit adjustment under CW or single-tone conditions, the average anode current may be as high as 250 mAdc, but care must be taken to keep the time period when the current is above the rating as brief as possible in order to prevent tube overheating.

HIGH VOLTAGE - The 6816, 6884, and 7843 operate at voltages which can be deadly and the equipment must be designed properly and operating precautions must be followed. Equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

MECHANICAL

MOUNTING & SOCKETING - The 6816, 6884, and 7843 may be mounted in any position. Sockets such as the E.F. Johnson 124-152-1, Erie 2948-000, Jettron 89-001, or equivalent may be used as long as there are no unusual circumstances which would allow the ceramic/metal base seal temperatures to exceed the rated maximum of 250°C. Mounting should be such that free movement of air past the base by convection is possible, or when forced-air cooling is being provided for the anode, some of this air may be bled off to provide for come circulation past the tube base.

The 7843 mounting is normally controlled by its heat-sink configuration and location. If air movement is restricted in the base area, the socket may also require coupling to a heat sink in order to limit base seal temperatures.

VIBRATION - These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration more severe than this are expected, it is suggested the EIMAC 7457 be employed.

COOLING (6816 & 6884) - Forced-air cooling must be provided to maintain the anode core and seal temperatures within the maximum rating. For best cooling efficiency a close-fitting insulated cowl assembly should be used to direct air past the anode cooling fins, and with such a cowl 12 cfm of air at 50°C maximum at sea level is sufficient to limit the anode core temperature to 225°C. With a short section of cowl, the required pressure drop to produce this air flow is approximately 0.1 inch of water. At higher altitudes, additional air is required. For 10,000 feet, for example, flow rate and pressure drop values will both increase by a factor of 1.46. The equipment designer is cautioned to allow for some air circulation around the base of the tube to maintain temperatures well within ratings, and if necessary some of the air available for anode cooling should be bled into the vicinity of the base to provide a small amount of forced circulation.

COOLING (7843) - This tube is designed for use in a conduction-cooled system, where tube anode heat is transferred to a heat sink, which in turn may be cooled by natural (free) convection, forced-air convection, liquid cooling, or a combination of these methods. Anode dissipation is normally limited only by the allowable temperature rise for the seals and the anode core. The nominal dissipation rating of 115 watts may be realized with relatively simple heat sink configurations, with higher dissipation levels possible with more

thorough designs. In all cases, however, the cooling system must maintain the anode and ceramic/metal seal temperatures below 250°C, and in cases where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial.

Intimacy of contact and pressure are two factors which will effect transfer of heat from the tube anode to the heat sink. A good thermally conductive compound should be used in the interface between the anode and the sink to reduce thermal resistance of the joint. Examples of commercially available thermal joint compound are:

WAKEFIELD 120-Wakefield Engineering Co,, Wakefield, MA 01880.
DOW CORNING 340-Dow Corning Corp., Midland, MI 48640.
ASTRODYNE THERMAL BOND 312-Astrodyne Inc., Burlington, MA 01803.
G.E. INSULGREASE G641-General Electric Co., Cleveland, OH 44117.

The designer is cautioned to allow for some movement in the socket mount to assure that the anode makes good contact to its heat sink without interference. If the tube anode and the sink are not making intimate contact, heat transfer will be seriously affected. The designer is encouraged to use temperature-sensitive paint or other temperature-sensing devices in connection with any equipment design before the layout is finalized.

GRID OPERATION - The maximum rated dc grid bias voltage is -100 volts and the maximum grid dissipation rating is 1.0 watts. In normal applications the grid dissipation will not approach the maximum rating.

At operating frequencies above the 100 MHz region, driving-power requirements for amplifiers increase noticeably. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory VHF/UHF operation of the tube in a stable amplifier is indicated by grid current values below approximately 15 mAdc.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 25,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen grid is 4.5 watts, and the screen input power should be kept below this level. The product of peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode. A series regulator circuit can be used only when an adequate bleeder resistor is provided.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be on before screen voltage can be applied.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is a good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

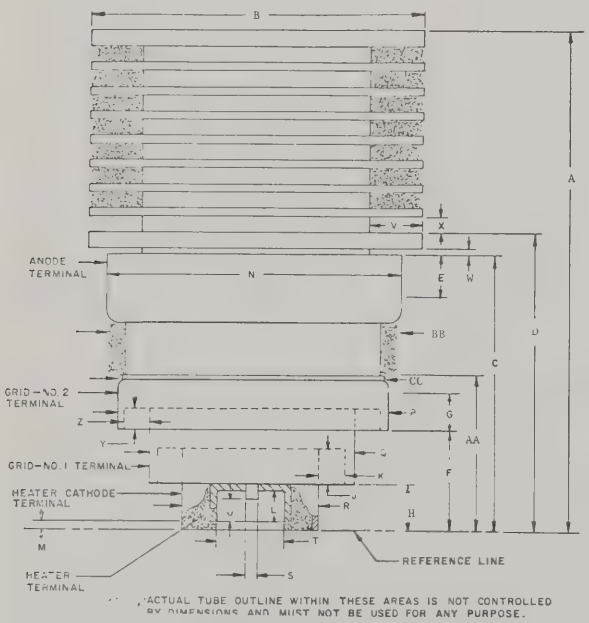
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event one tube fails.

VHF OPERATION - The 6816, 6884, and 7843 are suitable for use in the VHF/UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is increased by many variables in most applications, such as stray capacitance to the chassis,

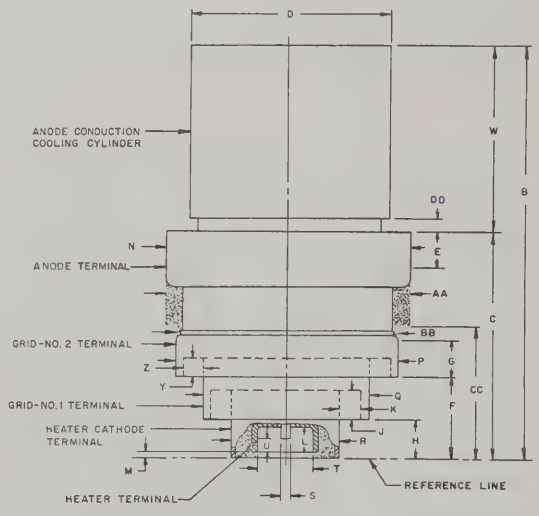
capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191. The equipment designer is therefore cautioned to make allowance for the additional capacitance values which will exist in any normal application. Actual measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - If it is desired to operate any of these tubes under conditions widely different from those given here, write to Power Grid Division, Attention: Applications, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.



ACTUAL TUBE OUTLINE WITHIN THESE AREAS IS NOT CONTROLLED BY DIMENSIONS AND MUST NOT BE USED FOR ANY PURPOSE.

6816/6884



ACTUAL TUBE OUTLINE WITHIN THESE AREAS IS NOT CONTROLLED BY DIMENSIONS AND MUST NOT BE USED FOR ANY PURPOSE.

7843

DIMENSIONAL DATA

DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	1.830	1.930	- -	46.48	49.02	- -
B	1.235	1.265	- -	31.37	32.13	- -
C	1.000	1.060	- -	25.40	26.92	- -
D	1.090	1.180	- -	27.26	29.97	- -
E	0.165	- -	- -	4.19	- -	- -
F	0.350	0.390	- -	8.89	9.91	- -
G	0.140	-	- -	3.56	- -	- -
H	0.160	0.190	- -	4.06	4.83	- -
J	0.120	- -	- -	3.05	- -	- -
K	0.095	- -	- -	2.41	- -	- -
L	0.100	- -	- -	3.05	- -	- -
M	- -	0.050	- -	- -	1.27	- -
N	1.085	- -	- -	27.56	- -	- -
P	0.985	- -	- -	25.02	- -	- -
Q	0.735	- -	- -	18.67	- -	- -
R	0.480	- -	- -	12.19	- -	- -
S	- -	0.072	- -	- -	1.83	- -
T	0.240	0.260	- -	6.10	6.60	- -
U	0.054	- -	- -	1.37	- -	- -
V	0.200	- -	- -	5.08	- -	- -
W	0.035	- -	- -	0.89	- -	- -
X	0.050	- -	- -	1.27	- -	- -
Y	0.060	- -	- -	1.52	- -	- -
Z	0.090	- -	- -	2.29	- -	- -
AA	0.600	- -	- -	15.24	- -	- -
BB	- -	1.120	- -	- -	28.45	- -
CC	- -	1.020	- -	- -	25.91	- -

NOTE: With the cylindrical surfaces of anode terminal, screen grid terminal, control grid terminal, heater-cathode terminal, and heater terminal clean, smooth, and free from burrs, the tube shall enter a gage which defines diameters which are concentric within 0.001 inch (0.03 mm), with diameters as follows:

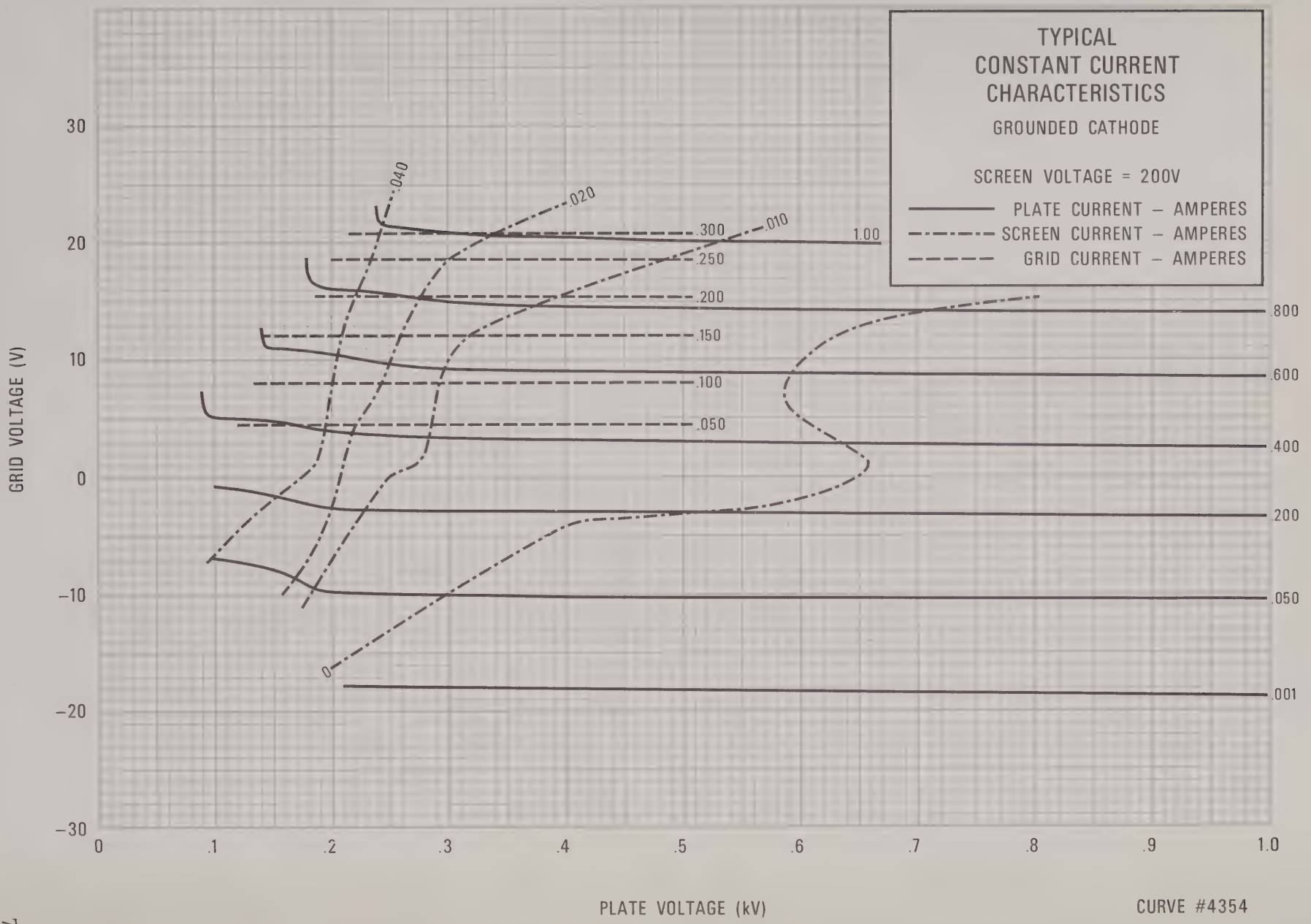
Radiator band	1.316 in.	33.43 mm
Anode terminal	1.120	28.45
Grid No. 2 (screen) terminal	1.020	25.91
Grid No. 1 (control) terminal	0.765	19.43
Heater-cathode terminal	0.520	13.21
Heater terminal	0.240	6.10
Axial Pin	0.072	1.83

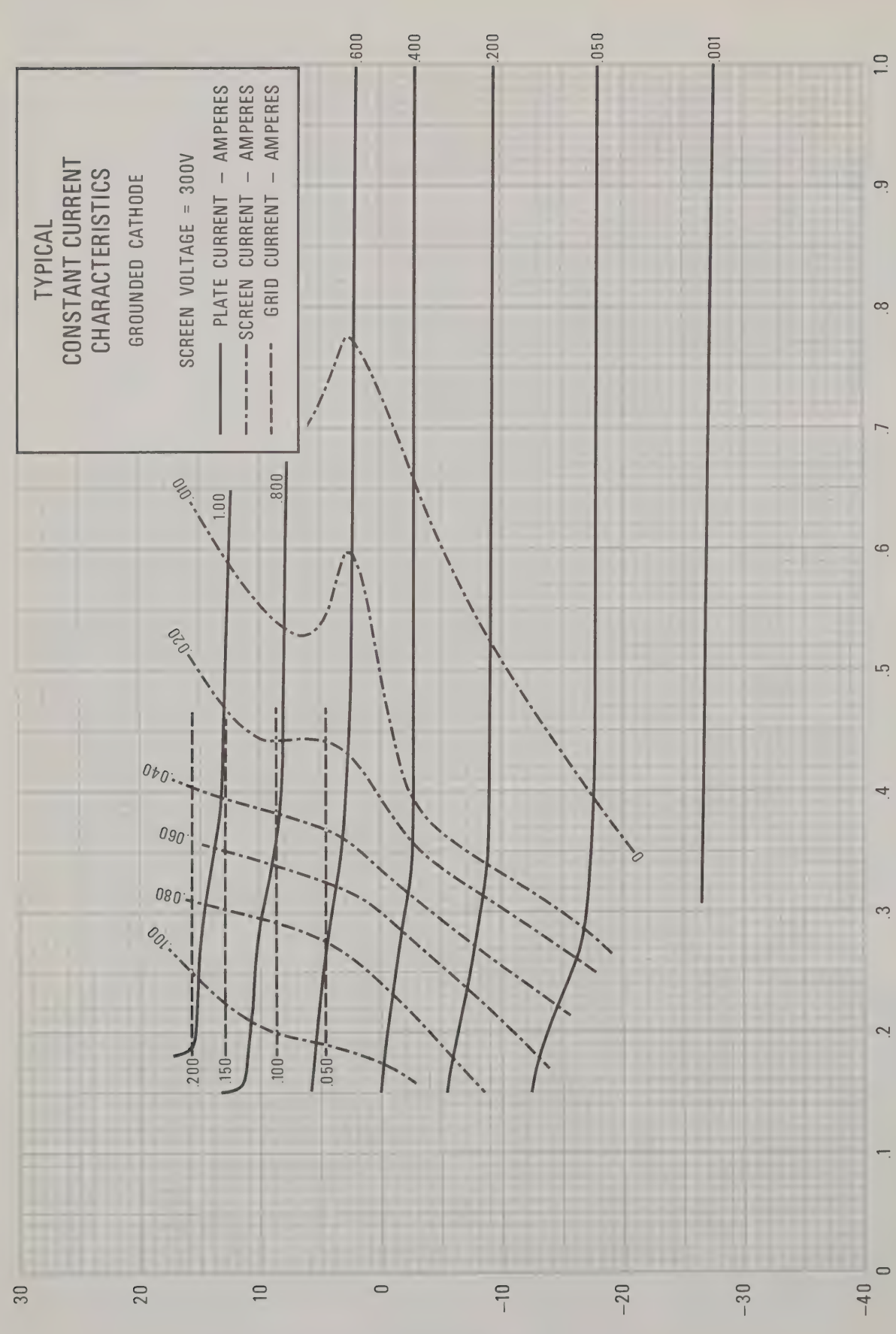
DIMENSIONAL DATA

DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
B	1.805	1.955	- -	45.85	49.66	- -
C	0.990	1.080	- -	25.15	27.43	- -
D	0.895	0.905	- -	22.73	22.99	- -
E	0.165	- -	- -	4.19	- -	- -
F	0.340	0.410	- -	8.64	10.41	- -
G	0.140	- -	- -	3.56	- -	- -
H	0.150	0.200	- -	3.81	5.08	- -
J	0.120	- -	- -	3.05	- -	- -
K	0.095	- -	- -	2.41	- -	- -
L	0.100	- -	- -	2.54	- -	- -
M	0	0.050	- -	0	1.27	- -
N	1.085	- -	- -	27.56	- -	- -
P	0.985	- -	- -	25.02	- -	- -
Q	0.735	- -	- -	18.67	- -	- -
R	0.480	- -	- -	12.12	- -	- -
S	- -	0.072	- -	- -	1.83	- -
T	- -	0.260	- -	- -	6.60	- -
U	0.054	- -	- -	1.37	- -	- -
W	0.780	- -	- -	19.81	- -	- -
Y	0.060	- -	- -	1.52	- -	- -
Z	0.090	- -	- -	2.29	- -	- -
AA	- -	1.120	- -	- -	28.45	- -
BB	- -	1.020	- -	- -	25.91	- -
CC	0.600	- -	- -	15.24	- -	- -
DD	0	- -	- -	0	- -	- -

NOTE: With the cylindrical surfaces of anode terminal, screen grid terminal, control grid terminal, heater-cathode terminal, and heater terminal clean, smooth, and free from burrs, the tube shall enter a gage which defines diameters which are concentric within 0.001 inch (0.03 mm), with diameters as follows:

Anode proper	0.952 in.	24.19 mm
Anode terminal	1.120	28.45
Grid No. 2 (screen) terminal	1.020	25.91
Grid No. 1 (control) terminal	0.765	19.43
Heater-cathode terminal	0.520	13.21
Heater terminal	0.240	6.10
Axial pin	0.072	1.83


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 200V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
30
20
10
0
−10
−20
−30
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
PLATE VOLTAGE (kV)
.040
.020
.010
0
.300
.250
.200
.150
.100
.050
1.00
.800
.600
.400
.200
.050
.001
CURVE #4354


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
SCREEN VOLTAGE = 300V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
.600
.400
.200
.050
.001
.010
1.00
.800
.020
.040
.060
.080
.100
.200
.150
.100
.050
0
30
20
10
0
–10
–20
–30
–40
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)

CURVE #4355

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

7580

RADIAL-BEAM POWER TETRODE



The 7580 is a compact, high-perveance, radial-beam tetrode designed specially for maximum power output as a class-AB_1 linear amplifier. It is capable of 470 watts peak envelope power output under two-tone conditions. A pair of 7580 tubes will provide audio or ultrasonic power of 595 watts operating in amplifier or modulator service, class-AB_1, with a transformer efficiency of 95%.

The upper frequency for use of the 7580 at maximum ratings is 500 megacycles.

GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-Coated, Unipotential				
	Heating Time	30	60		seconds
	Cathode-to-Heater Potential	—		±150	volts
Heater:	Voltage	-	6.0		volts
	Current	2.3		2.9	amperes
Direct Interelectrode Capacitances, Grounded Cathode:					
	Input	16.0		18.5	uuf
	Output	4.0		5.0	uuf
	Grid-to-Plate	-	-	0.06	uuf

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	250°C
Anode Core	250°C
Recommended Socket	Eimac SK-600 Series
Operating Position	Any
Maximum Dimensions:	
Height	2.464 inches
Seated Height	1.910 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 - Single Sideband

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	.250 MAX. AMP
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS

TYPICAL OPERATION

Two-Tone where peak envelope power is at least twice the average power output—Actual measurements—Tank circuit efficiency estimated at 95%.

D-C Plate Voltage	1500	2000	volts
Zero-Signal D-C Plate Current	.133	.070	amp
Two-Tone D-C Plate Current	.250	.245	amp
D-C Screen Voltage	350	400	volts
Two-Tone D-C Screen Current	—10	+1	ma
D-C Grid-Bias Voltage	—62	—80	volts
Peak Signal Voltage	56	80	volts
3rd Order Intermodulation products referred to signal level	—30	—23	db
5th Order Intermodulation products referred to signal level	—35	—27	db
Worst 3rd Order Intermodulation as drive signal is reduced	—29	—21	db
Load Resistance	2160	2840	ohms
Peak Envelope Power	262	470	watts

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RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier with Double Sidebands)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	.250 MAX. AMP
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS

TYPICAL OPERATION—Single Tube

(Quantities shown for carrier conditions, no modulation)

D-C Plate Voltage	1500	2000	volts
D-C Plate Current	.172	.172	amp
D-C Screen Voltage	350	400	volts
D-C Screen Current (Approx)	—3	—5	ma
D-C Grid-Bias Voltage	—58	—76	volts
Peak Grid-Signal Voltage	30	39	volts
Plate-Load Resistance	2320	3150	ohms
Power Output for Tank Circuit Efficiency of 95%	55	100	watts

AUDIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	500 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	.250 MAX. AMP
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS

TYPICAL OPERATION (Two Tubes Push-Pull)

D-C Plate Voltage	1500	2000	volts
D-C Plate Current No Signal	.200	.140	amp
D-C Plate Current at Full Signal	.490	.500	amp
D-C Screen Voltage	300	350	volts
D-C Screen Current No Signal	—2	—4	ma
D-C Screen Current at Full Signal	0	+4	ma
D-C Grid-Bias Voltage (Approx)	—48	—66	volts
Plate-to-Plate Load Resistance	5920	8016	ohms
Power Output for Transformer Efficiency of 95%	390	595	watts

MAXIMUM RATINGS FOR OTHER TYPES OF OPERATION

Class-C Telegraphy or FM

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	.250 MAX. AMP
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

Class-C Plate Modulated

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	.200 MAX. AMP
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

APPLICATION

MECHANICAL

Mounting—The 7580 may be mounted in any position. An Eimac Air-System Socket of the SK-600 series or equivalent is recommended. These sockets may be obtained with or without the r-f screen by-pass capacitor, and with or without the four cathode terminals grounded to the socket shell. A simple Lock-in socket restricts the flow of cooling air and is not recommended.

Cooling—The 7580 has an efficient louvered anode cooler. The maximum allowable temperature for any external surface is 250°C.

For long service life at sea level, at an ambient temperature of 25°C and maximum rated anode dissipation of 250 watts, a *minimum* of 4.6 cfm air should flow from tube base through the anode cooler. The corresponding pressure drop with the recommended socket and chimney will be approximately .32 inch water column. See table for other dissipation levels and conditions.

4.6 cfm of air at 25°C is the same as a mass air flow of 18 pounds per hour. Higher ambient temperature requires greater air mass and volume. Higher altitude requires equivalent mass air flow for a given ambient temperature and therefore requires greater volume at increased back pressure.

The use of temperature-sensitive laquer is recommended to determine the effectiveness of a cooling system under operating conditions.

Plate Dissipation (Watts)	55°C AMBIENT			
	SEA LEVEL		10,000 FEET ALTITUDE	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
75	1.15	.025	1.8	.036
125	2.3	.09	3.35	.13
250	6.4	.59	9.3	.86

Vibration and Shock—The 7580 is designed to withstand low-frequency vibration of 25 cps, 0.80 inch total excursion as outlined in MIL-E-1D, no voltage. It will withstand a bump test as described in MIL-E-1D for a hammer angle of 20°.

ELECTRICAL

Heater—For maximum life and uniform performance, the heater voltage should be maintained within plus or minus 5% of the rated 6.0 volts at operating frequencies up to 300 Mc. For CW use between 300 and 400 Mc, 5.75 volts is recommended. For CW use, 400 to 500 Mc, 5.5 volts is recommended.

Cathode—The cathode is connected to the four even-numbered base pins to provide a low-inductance path, or permit separation of input and output circuits if required.

Rated heater voltage should be applied for 30 seconds before other operating voltages are applied.

Heater-to-cathode maximum voltage is ±150 volts.

Control Grid—Maximum rated d-c bias voltage is −250 volts. D-C resistance, grid to cathode, should be no more than 100,000 ohms.

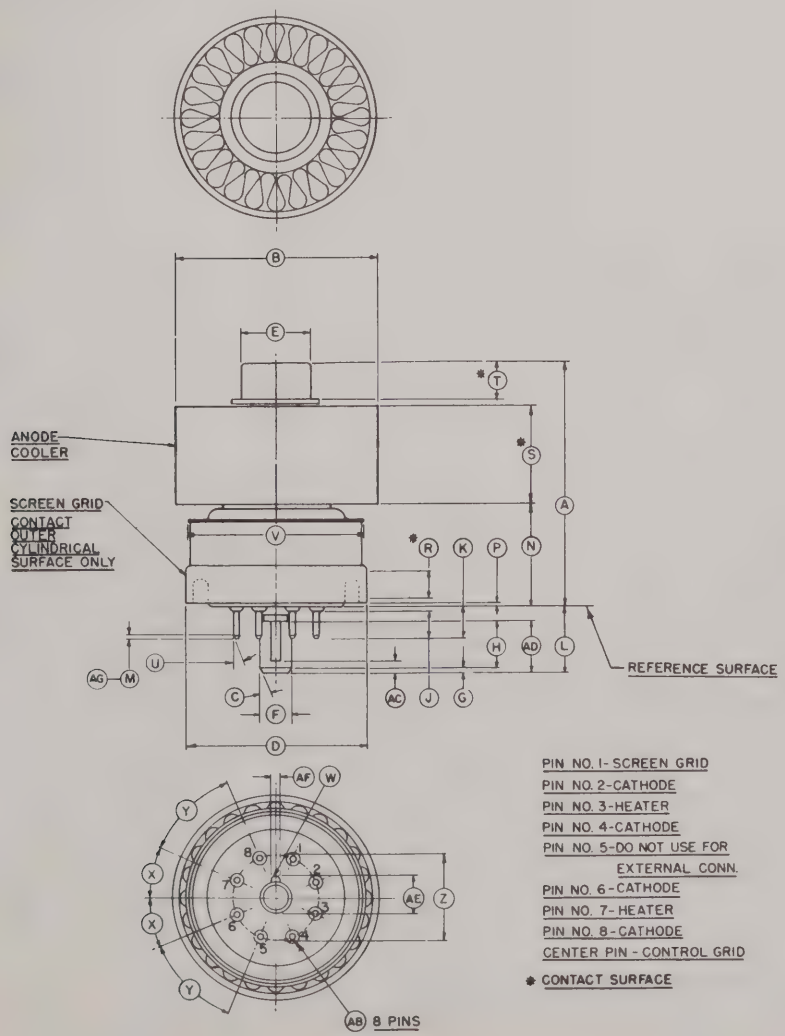
Screen Grid—Screen dissipation maximum is 12 watts, normally computed by multiplying d-c screen voltage by the average screen current. This computation is essentially correct except in the case of heavy plate loading when secondary-emission current may mask the normal screen current.

All tetrodes, under some conditions of loading and drive, will have secondary emission from the screen which changes the net current to the screen and may even cause the screen meter to reverse. Normally, secondary emission is harmless provided the screen voltage is stable. To insure stable screen voltage, it is recommended that a bleeder resistor to pass 15 ma from screen to ground be used.

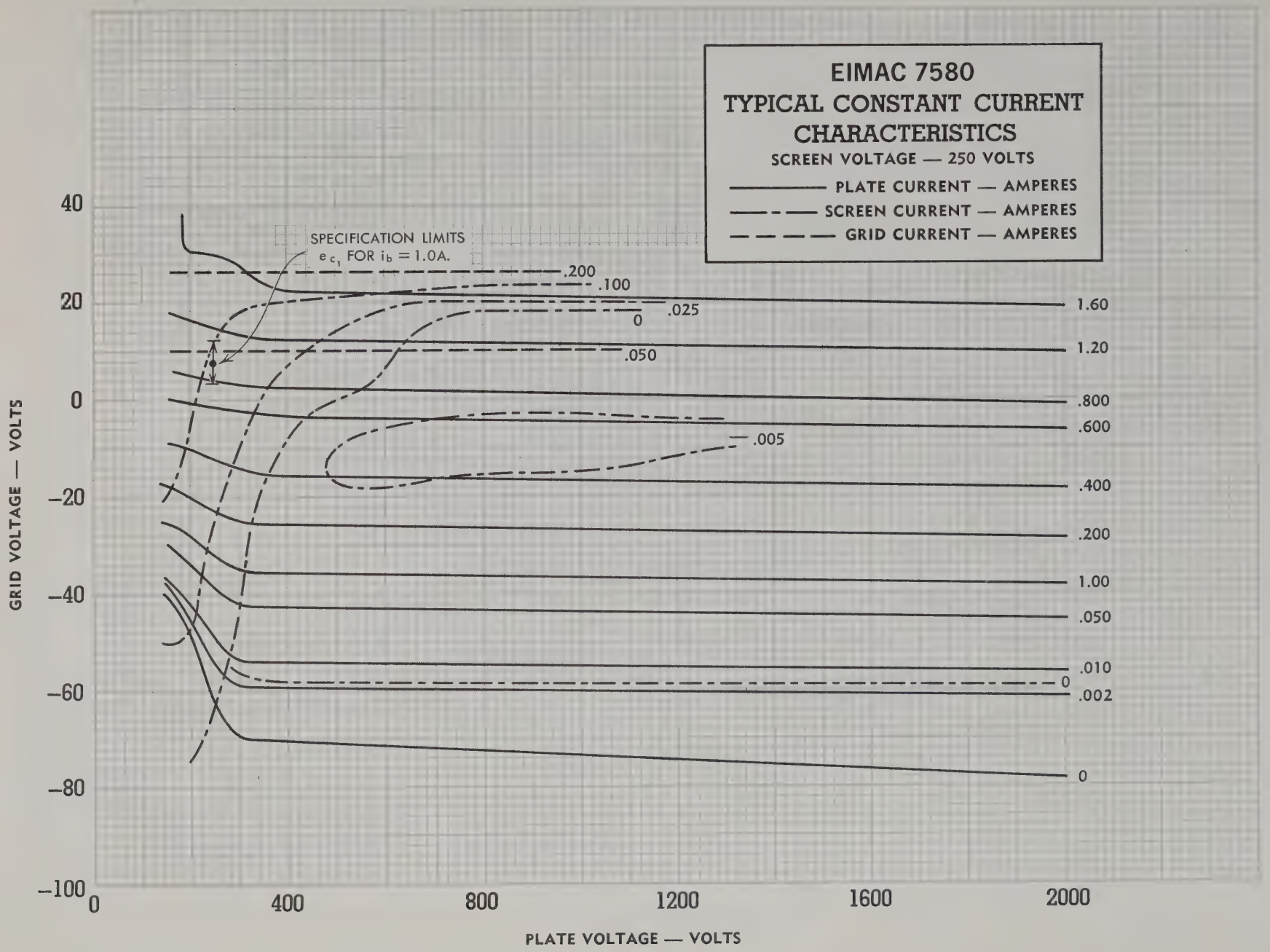
Plate Dissipation—The maximum plate dissipation is 250 watts. The usual single-sideband voice signal is complex and full peak envelope power shown in Typical Operating Conditions, may be developed without exceeding this plate dissipation. Single-tone testing for short periods with greater than 250 watts plate dissipation is permissible.

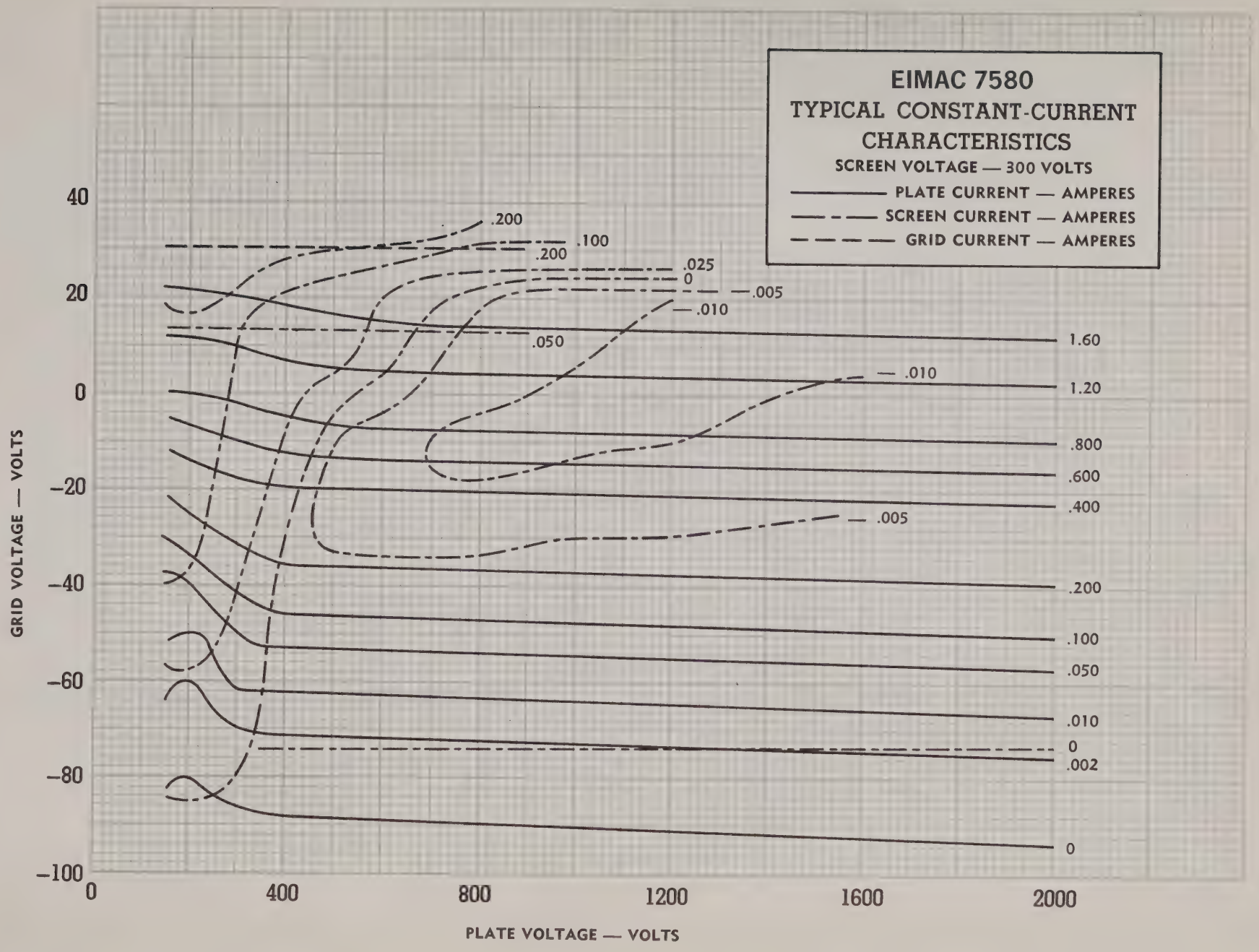
Multiple Operation — To obtain maximum power with minimum distortion from tubes operated in multiple it is desirable to adjust individual screen or grid-bias voltages so the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual d-c plate currents will be approximately equal for full input signal for class-AB_1 operation.

Special Application—If it is desired to use the 7580 under conditions widely different from those given here, consult the Power Grid Tube Marketing Department, Eitel-McCullough, Inc., San Carlos, California, or any of our regional offices or representatives.



DIMENSIONS IN INCHES		
REF.	MIN.	MAX.
A	1.810	1.910
B	1.610 DIA.	1.640 DIA.
C	30°	
D	1.417 DIA.	1.433 DIA.
E	.559 DIA.	.573 DIA.
F	.255 DIA.	.265 DIA.
G	.031	
H	.360	
J	.187	
K		.250
L	.514	.554
M	.035	
N	.750	.810
P	.020	
R	.187	
S	.710	.790
T	.240	.280
U	22 1/2°	
V		1.406 DIA.
W		.043 R.
X	22 1/2°	
Y	45°	
Z	.680 DIA. P.C.	.694 DIA. P.C.
AB	.045 DIA.	.053 DIA.
AC	.068	.108
AD		.456
AE	.298	.308
AF	.078	.086
AG	.005 R. MIN. (ALTERNATE TO M&U)	


EIMAC 7580
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
SPECIFICATION LIMITS
e_{c_1} FOR i_b = 1.0A.
.200
.100
.025
0
.050
.005
1.60
1.20
.800
.600
.400
.200
1.00
.050
.010
0
.002
0
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS


EIMAC 7580
TYPICAL CONSTANT-CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 300 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
.200
.100
.200
.025
0
.005
.010
.050
1.60
.010
1.20
.800
.600
.400
.005
.200
.100
.050
.010
0
.002
0

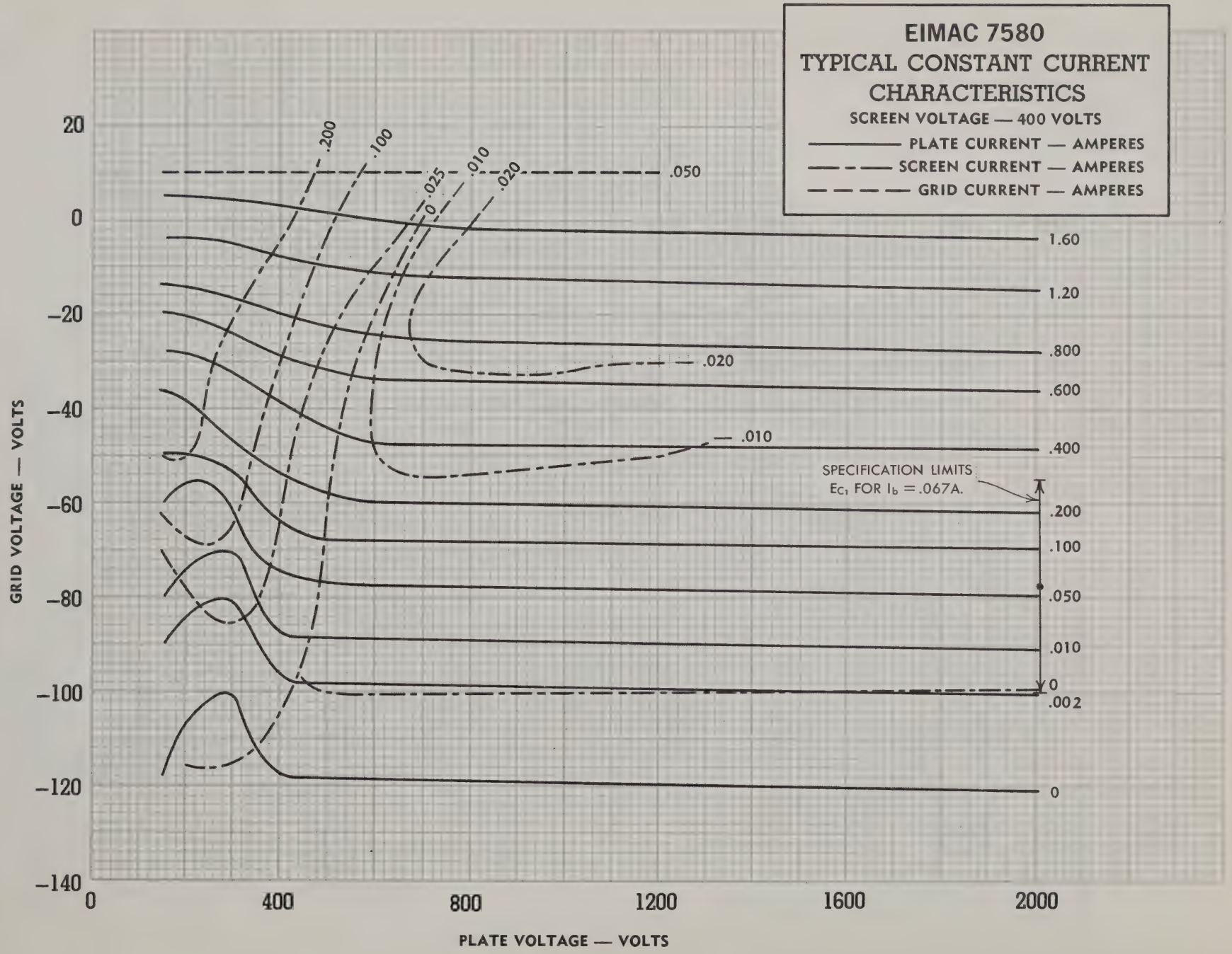
EIMAC 7580
TYPICAL CONSTANT CURRENT CHARACTERISTICS

SCREEN VOLTAGE — 400 VOLTS

——— PLATE CURRENT — AMPERES

— — — SCREEN CURRENT — AMPERES

— — — — GRID CURRENT — AMPERES



Printed in U.S.A. 948

EIMAC
Division of Varian

264/8576

RADIAL BEAM POWER PENTODE

The EIMAC 264/8576 is a ceramic/metal, forced-air cooled, radial beam pentode with a rated maximum plate dissipation of 3000 watts. The tube has very low input capacitance for its power-handling capability. It is well suited for use in broad-band linear amplifiers or in other high-performance Class AB_1 amplifier applications.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	17	A
Transconductance (Average):		
I_b = 2.0 Adc, E_{c_2} = 750 Vdc	37,000	μmhos
Direct Interelectrode Capacitances (grounded cathode)[2]		
Input	55	pF
Output	18	pF
Feedback	0.13	pF
Frequency of Maximum Rating:		
CW	30	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	6.188 in; 157.18 mm
Diameter	4.438 in; 112.73 mm
Net Weight	3.9 lb;1.77 kg
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250 °C
Anode Core	250 °C
Cooling	Forced Air
Base	7-Pin Special
Recommended Air-System Socket	EIMAC SK-265A
Recommended Air Chimney (included with SK-265A)	EIMAC C-265

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RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN

Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	5000 VOLTS
DC SUPPRESSOR VOLTAGE	100 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	2.0 AMPERES
PLATE DISSIPATION	3000 WATTS
SCREEN DISSIPATION	50 WATTS
GRID DISSIPATION	2 WATTS

1. Adjust to specified zero-signal dc plate current.
2. Except for brief tuneup periods, operation under single tone conditions may not be possible due to excessive screen current.
3. The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum output power and are referenced against one tone of a two equal tone signal. No degenerative feedback.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	4000	5000	5000	Vdc
Suppressor Voltage	0	0	0	Vdc
Screen Voltage	650	650	750	Vdc
Grid Voltage[1]	-92	-93	-109	Vdc
Zero-Signal Plate Current	400	400	400	mAdc
Single-Tone Plate Current	1.43	1.36	1.69	Adc
Two-Tone Plate Current	0.95	0.91	1.09	Adc
Zero-Signal Screen Current[4]	7	6	7	mAdc
Single-Tone Screen Current[2,4]	58	55	80	mAdc
Two-Tone Screen Current[4]	26	23	32	mAdc
Peak rf Grid Voltage[4]	92	90	108	v
Useful Output Power[5]	3300	4400	5500	W
Resonant Load Impedance	1350	1950	1550	Ω
Intermodulation Distortion Products[3]				
3rd Order	-28	-29	-26	db
5th Order	-45	-45	-40	db

4. Approximate values.
5. Actual power output delivered to the load from a typical amplifier.

APPLICATION

MOUNTING - The 264/8576 may be operated in any position, and should normally be mounted in the air-system socket EIMAC type SK-265A, with a C-265 chimney. The SK-265A has a built-in bypass capacitor for the screen grid, and the suppressor grid contacts are grounded.

AIR SYSTEM SOCKET AND CHIMNEY - The SK-265A socket makes all electrical contacts to the 264/8576 except to the anode. The suppressor grid contact is grounded to the socket shell. An integral screen grid bypass capacitor is included, with a capacitance of 2000 pF and rated for 1000 Vdc maximum.
The C-265 air chimney is designed to mate with the SK-265A socket and guide the cooling air through the anode cooling fins of the tube.

COOLING - Forced-air cooling is required in all applications, and the use of an air-system socket, such as the EIMAC SK-265A, with a C-265 chimney, is recommended. Cooling is simplified if air is directed in a base-to-anode direction; when so directed, with full rated anode dissipation and with air at 50°C at sea level, an air flow of 110 cubic feet per minute, with a resultant pressure drop of approximately 0.95 inch of water for the tube/socket/chimney combination, is sufficient to limit the maximum tube temperature to 225°C. If air is not directed in the base-to-anode direction, additional cooling may be required for the base section of the tube. Cooling air should be supplied before or simultaneously with the application of electrode voltages, including heater, and should normally be maintained for a brief period after electrode voltages are removed to allow for tube cooldown.

HEATER - The rated heater voltage for the 264/8576 is 6.0 volts, as measured at the socket or tube base pins. Variations should be restricted to plus or minus 0.3 volts for long tube life and consistent performance.

GRID OPERATION - Grid-bias voltage must be obtained from a fixed bias supply in Class AB applications. The internal resistance of the bias source should not exceed 2500 ohms.

SCREEN OPERATION - In linear amplifier service, the screen voltage must be obtained from a well regulated source, to prevent excessive screen voltage variations due to changes in screen current which occur between zero-signal and full-signal conditions. The circuit should be arranged so that it is impossible to apply screen voltage without plate voltage. The use of a screen grid over-current relay is recommended, to remove screen voltage immediately in case of excessive screen current due to circuit problems, grid bias failure, or accidental removal of plate circuit loading. The relay should not break the screen-cathode d-c ground return path.

PLATE OPERATION - The maximum rated plate dissipation power for the 264/8576 is 3000 watts. Except for brief periods during circuit adjustment, this maximum value should not be exceeded. Contact to the plate may be made either at the top cap or by means of a circular clamp or spring-finger collet around the outer surface of the anode cooler itself. Points of electrical contact with the anode should be kept clean and free of oxide to minimize rf loss. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

NEUTRALIZATION FOR RF OPERATION - For minimum-distortion Class AB1 linear amplifier service, where reaction on the driver circuit should be eliminated completely, it will usually be found advisable to neutralize the small feedback capacitance of the tube.

GENERAL OPERATION NOTES - A metal chassis or equivalent means should be provided to separate the input and output circuits of an rf amplifier employing the 264/8576. Reasonable precautions should be observed in regard to bypassing and shielding of supply leads to prevent coupling between input and output through external circuits. The use of the EIMAC SK-265A air-system socket, with its integral screen grid bypass capacitance built in, is helpful in these respects.

SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.

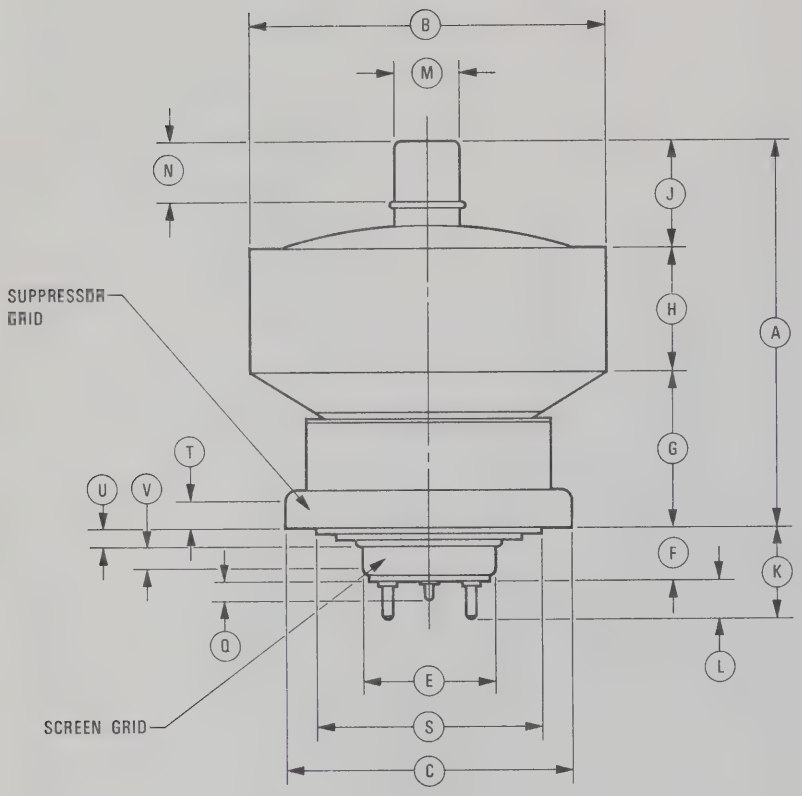
NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current.

RANGE VALUES FOR EQUIPMENT DESIGN

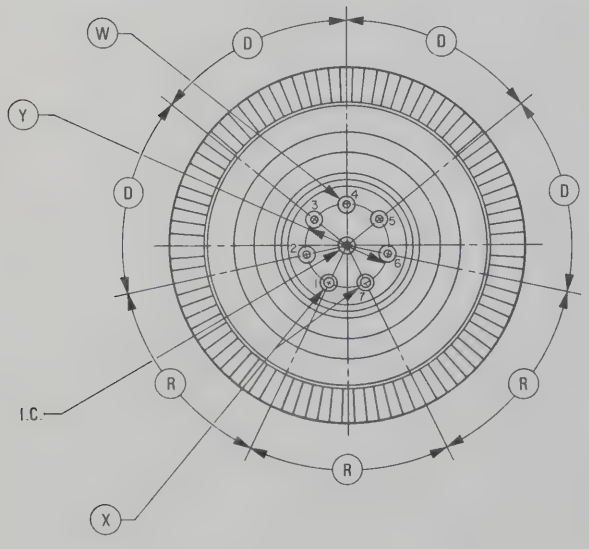
	Min.	Max.	
Heater: Current at 6.0 volts	15.5	18.5	A
Cathode Warmup Time[1]	5	---	minutes
Interelectrode Capacitances[2] (grounded cathode connection)			
Input	51.0	61.0	pF
Output	14.0	22.0	pF
Feedback	---	0.16	pF

1. Heater voltage should normally be applied for the stated time before voltages are applied to the other tube elements.

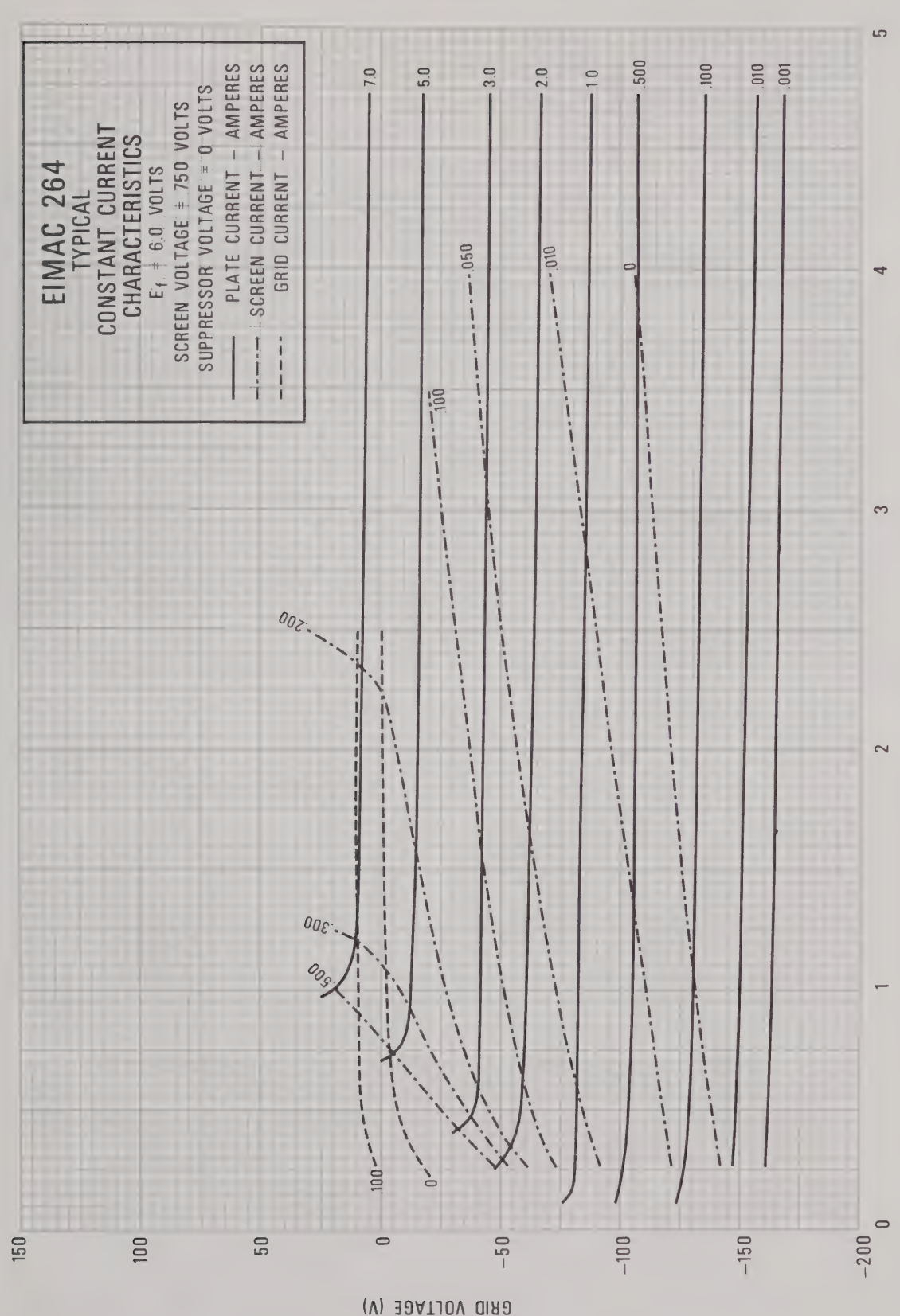
2. Capacitance values are for a cold tube as measured in a special shielded fixture.



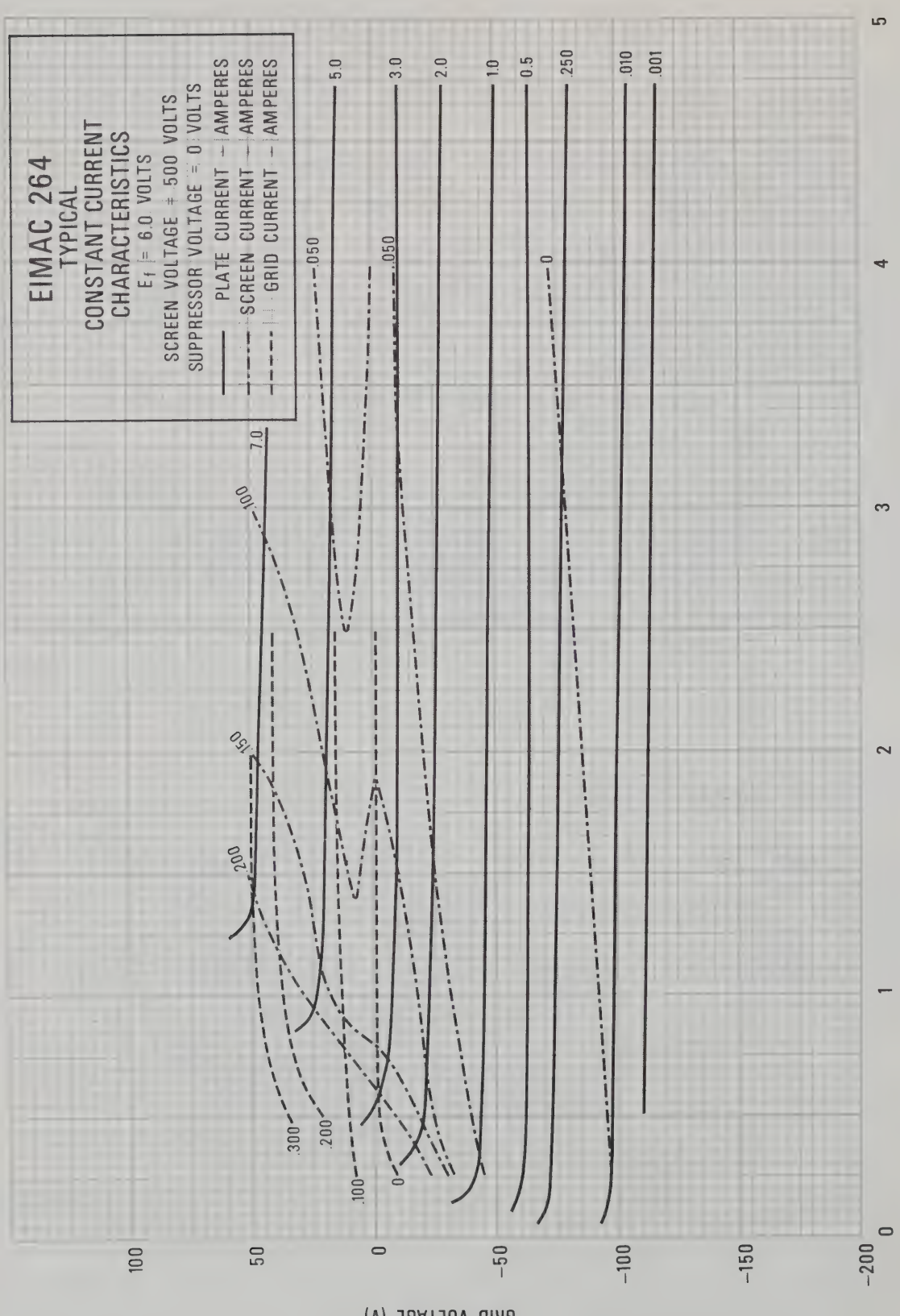
DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	— —	4.828	— —	122.63
B	4.374	4.438	111.09	112.72
C	3.484	3.516	88.49	89.31
E	1.615	1.630	41.02	41.40
F	0.625	0.750	15.87	19.05
G	1.813	1.937	46.05	49.20
H	1.530	1.560	38.86	39.62
J	1.219	1.343	30.96	34.11
K	1.160	1.360	29.46	34.54
L	0.540	0.600	13.72	15.24
M	0.805	0.819	20.45	20.80
N	0.688	— —	17.47	— —
S	— —	2.812	— —	71.42
T	0.350	— —	8.89	— —
V	0.220	— —	5.60	— —
W	0.122	0.128	3.10	3.25
X	0.149	0.159	3.78	4.04
REFERENCE DIMENSIONS				
D	51°		51°	
Q	0.205		5.21	
R	52°		52°	
U	0.250		6.35	
Y	1.000 DIA. P.C.		25.40 DIA. P.C.	



PIN CONNECTIONS	
PIN NO.	ELEMENT
1	k
2	g1
3	h
4	k
5	h
6	g1
7	k
CENTER PIN	INT. CON.
LOWER RING	g2
UPPER RING	g3
CAP	p


EIMAC 264
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.0 VOLTS
SCREEN VOLTAGE = 750 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
7.0
5.0
3.0
2.0
1.0
.500
.100
.010
.001
.100
.050
.010
0
200
300
500
100
0
GRID VOLTAGE (V)
150
100
50
0
-50
-100
-150
-200
0
1
2
3
4
5
PLATE VOLTAGE (KV)

CURVE #4105


EIMAC 264
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.0 VOLTS
SCREEN VOLTAGE = 500 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
7.0
5.0
3.0
2.0
1.0
0.5
.250
.010
.001
.050
.050
0
300
200
100
0
100
150
200
100
50
0
−50
−100
−150
−200
0
1
2
3
4
5
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)

CURVE #4106

TECHNICAL DATA

8828W

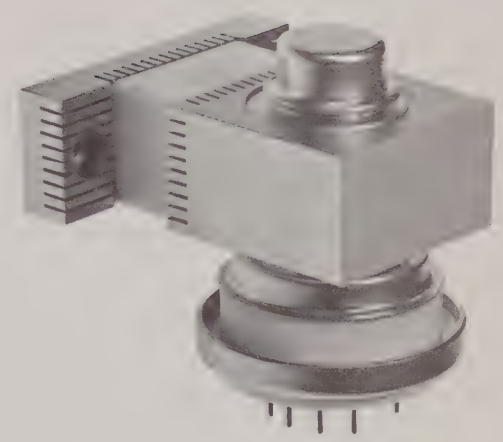
CONDUCTION-COOLED
RADIAL-BEAM
POWER TETRODE

The EIMAC 8828W is a compact external anode, conduction-cooled ceramic/metal radial-beam tetrode, for use in rf power amplifier or oscillator service and linear rf power amplifier applications.

The 8828W has a 26.5 volt heater and a nominal anode dissipation rating of 200 watts with simple heat sink designs. Higher dissipation is allowable with more sophisticated heat sink designs.

The rugged construction of this tube allows full-voltage operation under 50G, 11 millisecond shock conditions and vibrational stress of 10G up to 1000 Hz.

The EIMAC 8828W may be used as a direct replacement for its non-rugged prototype in most equipments.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential	
Heater Voltage	26.5 ± 10% V
Heater Current, at 26.5 volts	0.68 A
Cathode-Heater Potential, maximum	±150 V
Amplification Factor (Average):	
Grid to screen	11
Transconductance (Average):	
I_b = 200 mAdc, E_{c2} = 400 Vdc	25,000 μmhos
Direct Interelectrode Capacitance (Grounded Cathode) [2]	
Cin	36.5 pF
Cout	6.7 pF
Cgp	0.1 pF
Frequency of Maximum Rating:	
CW	500 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association Standard RS-191. The capacitance added externally by the conduction cooler is approximately 3 pF.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.260 in; 57.4 mm
Diameter	2.000 in; 50.8 mm
Net Weight	7.2 oz; 204 gm
Operating Position	Any

(Effective 2-15-72) © by Varian

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Cooling ..... Conduction Cooled
Operating Temperature, Maximum;
Ceramic/Metal Seals and Anode Core ..... 250°C
Base ..... Large Wafer Elevenar 11-Pin with Ring (JEDEC No. E11-81)
Recommended Sockets ..... E.F. Johnson #124-311-1
Erie #9802-000
Mycalex #CP464-2

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current, at 26.5 volts	0.62	0.74	A
Cathode Warmup Time	120	---	sec.
Interelectrode Capacitances (Grounded Cathode)[1]			
Cin	33.0	40.0	pF
Cout	6.0	7.5	pF
Cgp	---	0.13	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture, in accordance with Electronic Industries Association Standard RS-191. The capacitance added externally by the conduction cooler is approximately 3 pF.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy of FM Telephony (Key-Down Conditions - Frequencies to 500 MHz)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2200	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.3	AMPERE
PLATE DISSIPATION[1]	200	WATTS
SCREEN DISSIPATION	8	WATTS
GRID DISSIPATION	1	WATT

1. Higher dissipation obtainable depending on design of heat sink; see COOLING.

TYPICAL OPERATION (Frequencies to 50 MHz)

Plate Voltage	700	1000	1500	2000	Vdc
Screen Voltage	175	200	200	200	Vdc
Grid Voltage	-10	-30	-30	-30	Vdc
Plate Current	300	300	300	300	mAdc
Screen Current[1]	25	20	20	20	mAdc
Grid Current[1]	50	40	40	30	mAdc
Driving Power[1]	1.2	2.0	2.0	2.0	W
Useful Output Power[2]	120	175	275	375	W

1. Approximate value.
2. Delivered to the load.

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN Class AB1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE (to 30 MHz)	3000	VOLTS
(to 500 MHz)	2200	VOLTS
DC SCREEN VOLTAGE	400	VOLTS
DC GRID VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.3	AMPERE
PLATE DISSIPATION[1]	200	WATTS
SCREEN DISSIPATION	8	WATTS
GRID DISSIPATION	1	WATT

1. Higher dissipation obtainable depending on design of heat sink; see COOLING.

TYPICAL OPERATION (Frequencies to 30 MHz) Class AB1 Grid Driven, Peak Envelope or Modulation Crest Cond.

Plate Voltage	700	1000	1500	2000	Vdc
Screen Voltage	250	250	250	400	Vdc
Grid Voltage[1]	-20	-20	-20	-35	Vdc
Zero-Signal Plate Current	100	100	100	100	mAdc
Single-Tone Plate Current[2]	205	210	210	335	mAdc
Two-Tone Plate Current	150	160	160	250	mAdc
Single-Tone Screen Current[3]	16	10	10	10	mAdc
Two-Tone Screen Current[3]	10	7	7	7	mAdc
Resonant Load Impedance	1420	2270	3800	3050	Ohms
Useful Output Power[4]	80	110	170	380	W

1. Adjust to specified zero-signal dc plate current.
2. See ANODE CURRENT Application Note.
3. Approximate value.
4. Delivered to the load.

APPLICATION

MECHANICAL

MOUNTING & SOCKETING - The 8828W may be mounted in any position. Sockets such as E.F. Johnson #124-311-1, Erie #9802-000, Mycalex #CP464-2, or equivalent may be used as long as there are no unusual circumstances which would allow the ceramic/metal base seal temperatures to exceed the rated maximum of 250°C. Mounting should be such that free movement of air past the base by convection is possible, and is normally controlled by heat-sink configuration and location. If air movement is restricted in the base area, the socket may also require coupling to a heat sink in order to limit base seal temperatures.

ELECTRICAL

HEATER/CATHODE OPERATION - The rated heater voltage for the 8828W is 26.5 volts as measured at the base of the tube, and variations should be restricted to plus or minus ten percent. In cases where long life and consistent performance are a prime consideration, the heater may be operated at a slightly reduced voltage and when this is done regulation is required to restrict variation. At frequencies above approximately 300 MHz it may be necessary to reduce heater voltage to compensate for rf transit-time heating of the cathode after dynamic operation of the tube has started. This back heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. The following heater operating voltages are recommended for straight-through Class C amplifier operation:

Frequency (MHz)	Heater Voltage
300 or lower	26.5
301 to 400	25.5
401 to 500	24.5

The potential between the heater and the cathode should be limited to ±150 Vdc.

COOLING - The 8828W is designed for use in a conduction-cooled system where tube heat is transferred to a heat sink, which in turn may be cooled by natural (free) convection, forced-air convection, liquid cooling, or a combination of these methods. Anode dissipation is normally limited only by the allowable temperature rise for the seals and the anode core. The nominal dissipation rating of 200 watts may be realized with the simple heat sink configurations with a maximum temperature of approximately 125°C; higher dissipation levels are possible with more thorough designs, with the choice determined by the application. In all cases, however, the cooling system must maintain the anode and ceramic/metal seal temperatures below 250°C, and in cases where long life and consistent performance are factors, cooling in excess of absolute minimum requirements is normally beneficial.

Intimacy of contact and pressure are two factors which will effect transfer of heat from the tube anode to the heat sink. A good thermally conductive compound should be used in the interface between the metal shoe on the beryllium oxide (BeO) thermal link and the sink to reduce thermal resistance of the joint. Examples of commercially available thermal joint compound are:
WAKEFIELD 120-Wakefield Engineering Co., Wakefield, MA 01880.
DOW CORNING 340-Dow Corning Corp., Midland, MI 48640.
ASTRODYNE THERMAL BOND 312-Astrodyne Inc., Burlington, MA 01803.
G.E. INSULGREASE G641-General Electric Co., Cleveland, OH 44117.

The designer is cautioned to allow for some movement in the socket mount to assure that the anode makes good contact to its heat sink without interference. If the anode thermal link and the sink are not making intimate contact, heat transfer will be seriously affected. The designer is encouraged to use temperature-sensitive paint or other temperature-sensing devices in connection with any equipment design before the layout is finalized.

DANGER-BERYLLIUM OXIDE CERAMICS (BeO) - Do not alter, grind, lap, fire, chemically clean or perform any other operation on the BeO thermal link brazed to the anode of the 8828W. Normal use of beryllium oxide ceramics parts is not hazardous, but the user is cautioned that breathing small quantities of the dust or fumes from beryllium oxide can seriously injure or kill.

ANODE CURRENT - The 8828W is rated for 300 mAdc of continuous anode current. During short periods of circuit adjustment under CW or single-tone conditions, the average anode current may be as high as 450 mAdc, but care must be taken to keep the time period when the current is above

rating as brief as possible in order to prevent tube overheating.

HIGH VOLTAGE - The 8828W operates at voltages which can be deadly and the equipment must be designed properly and operating precautions must be followed. Equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

SHOCK AND VIBRATION - The EIMAC 8828W is designed to operate under shock or vibration conditions capable of disabling a conventional tube of similar power capability. With high voltage typical of normal use applied, these tubes are designed to perform reliably under 50G, 11 millisecond shock conditions or vibrational stress of 10G to a frequency of 1000 Hz. The equipment designer is cautioned to provide adequate support for the tube to prevent relative motion between tube and socket in equipments where shock and vibration stresses are anticipated.

GRID OPERATION - The maximum rated dc grid bias voltage is -100 volts and the maximum grid dissipation rating is 1.0 watts. In normal applications the grid dissipation will not approach the maximum rating.

At operating frequencies above the 100 MHz region, driving-power requirements for amplifiers increase noticeably. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid current values below approximately 30 mAdc.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 25,000 ohms.

SCREEN OPERATION - The maximum rated power dissipation for the screen grid is 8 watts, and the screen input power should be kept below this level. The product of peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor or shunt regulator connected between screen and cathode. A series regulator circuit can be used only when an adequate bleeder resistor is provided.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be on before screen voltage can be applied.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event one tube fails.

VHF OPERATION - The 8828W is suitable for use in the VHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

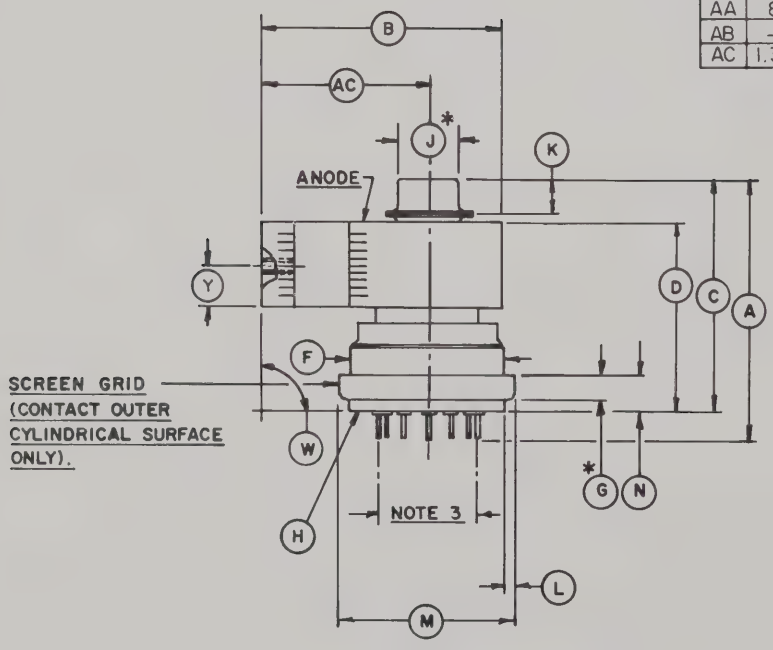
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is increased by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed

test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191. The equipment designer is therefore cautioned to make allowance for the additional capacitance values which will exist in any normal application. Actual measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

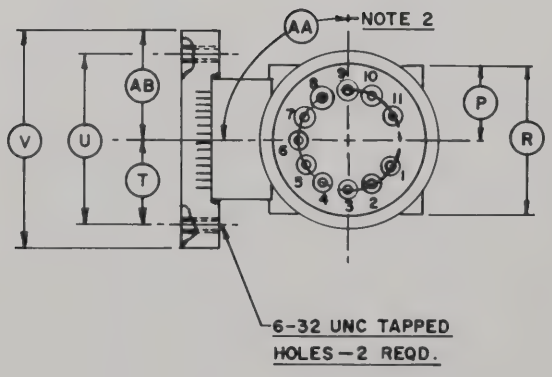
SPECIAL APPLICATIONS - If it is desired to operate any of these tubes under conditions widely different from those given here, write to Power Grid Division, Attention: Applications, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

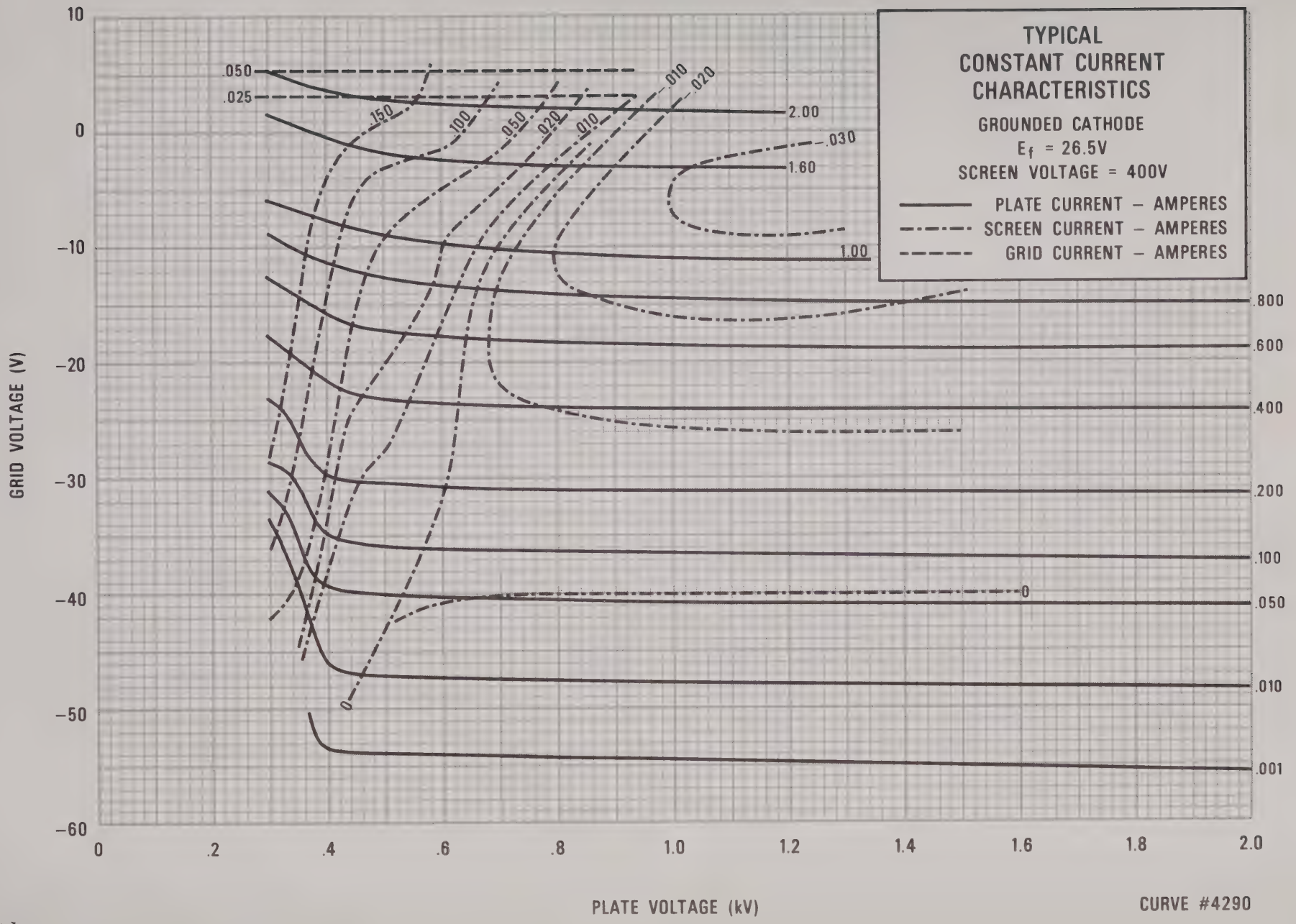
PIN NO. 1 CATHODE
PIN NO. 2 SCREEN GRID
PIN NO. 3 CONTROL GRID
PIN NO. 4 CATHODE
PIN NO. 5 HEATER
PIN NO. 6 HEATER
PIN NO. 7 SCREEN GRID
PIN NO. 8 CONTROL GRID
PIN NO. 9 CATHODE
PIN NO. 10 SCREEN GRID
PIN NO. 11 CONTROL GRID

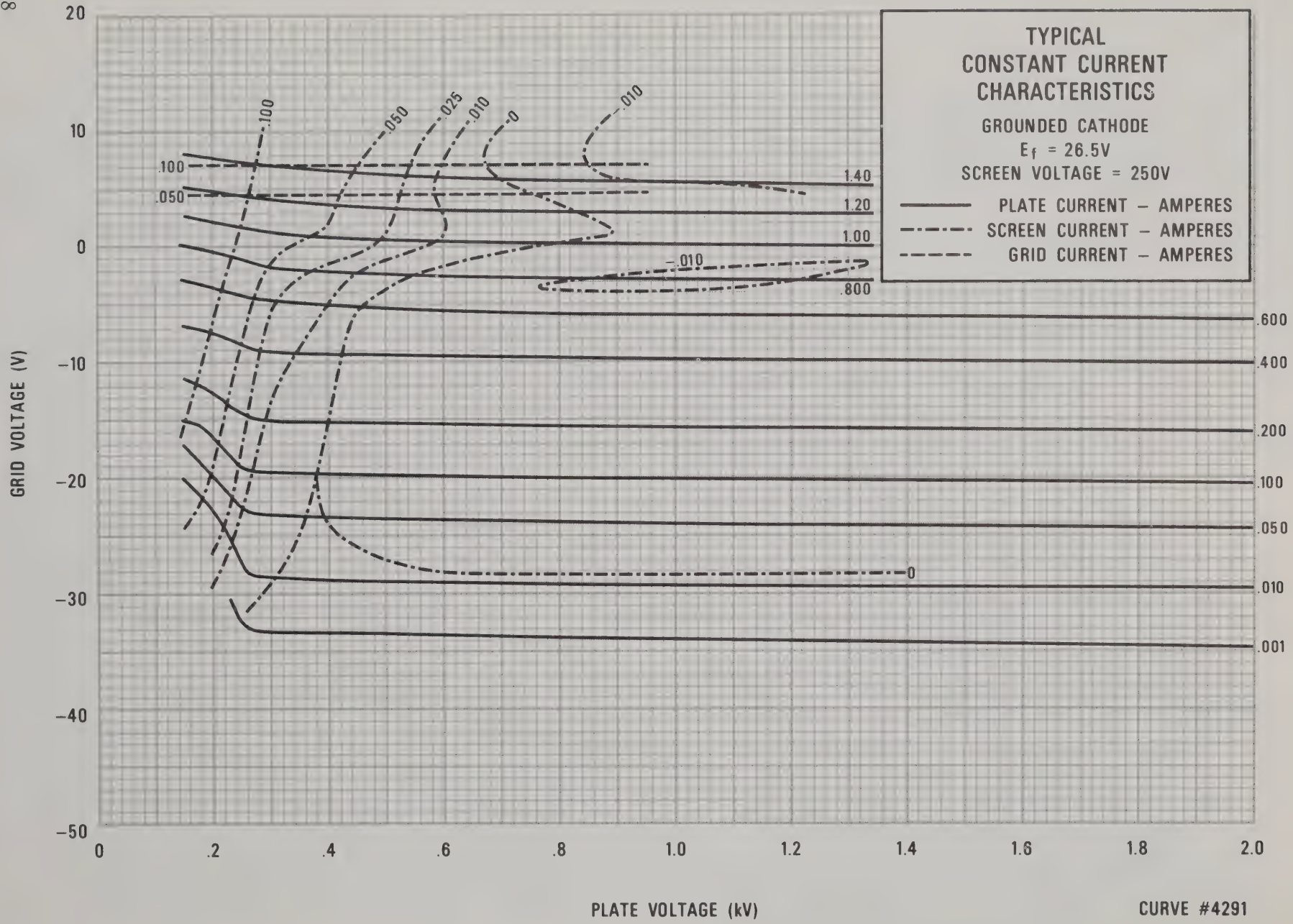
DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A		2.260	- -		57.40	- -
B		2.000	- -		50.80	- -
C		1.960	- -		49.78	- -
D	1.485	1.545	- -	37.72	39.24	- -
F		1.250	- -		31.75	- -
G	0.150		- -	3.81		- -
H	BASE: E11-81 JEDEC DESIGNATION					
J	0.559	0.573	- -	14.20	14.55	- -
K	0.240		- -	6.10		- -
L	0.080		- -	2.03		- -
M	1.416	1.436	- -	35.97	36.47	- -
N	0.280	0.320	- -	7.11	8.13	- -
P	0.588	0.598	- -	14.93	15.19	- -
R	1.172	1.202	- -	29.77	30.53	- -
T	0.680	0.695	- -	17.27	17.65	- -
U	1.367	1.383	- -	34.72	35.13	- -
V	1.730	1.770	- -	43.94	44.96	- -
W	89°	91°	- -	89°	91°	- -
Y	0.340	0.360	- -	8.64	9.14	- -
AA	89°	91°	- -	89°	91°	- -
AB	- -	- -	0.875	- -	- -	22.22
AC	1.347	1.407	- -	34.21	35.74	- -



NOTES:
1. REF. DIMENSIONS ARE FOR INFO. ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. FLAT LOCATION IN RELATION TO PIN 6.
3. PIN PITCH DIA TO BE CONCENTRIC TO DIM. M WITHIN .030 DIA.
4. * CONTACT SURFACE.




TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 26.5V
SCREEN VOLTAGE = 400V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
CURVE #4290
10
0
−10
−20
−30
−40
−50
−60
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
.050
.025
.150
.100
.050
.020
.010
.010
.020
2.00
1.60
1.00
.030
.800
.600
.400
.200
.100
.050
.010
.001
0
0


TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED CATHODE
E_f = 26.5V
SCREEN VOLTAGE = 250V
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
20
10
0
−10
−20
−30
−40
−50
0
.2
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
.100
.050
.025
.010
0
.010
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
.001

CURVE #4291

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

4E27A/5-125B

RADIAL-BEAM POWER PENTODE

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 4E27A/5-125B is a power pentode intended for use as a modulator, oscillator or amplifier. The driving-power requirement is very low, and neutralization problems are simplified or eliminated entirely. The tube has a maximum plate-dissipation rating of 125 watts and a maximum plate voltage rating of 4000 volts at frequencies up to 75 Mc. Cooling is by convection and radiation. Type 4E27A/5-125B unilaterally replaces type 4E27.

The 4E27A/5-125B in class-C r-f service will deliver up to 375 watts plate power output with less than 2 watts driving power. It will deliver up to 75 watts of carrier for suppressor modulation.

Two 4E27A/5-125B's will deliver up to 300 watts maximum-signal plate power output in class AB_1 modulator service, 400 watts in class AB_2 with less than 1 watt driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 volts
Current	7.5 amperes
Grid-Screen Amplification Factor (Average)	5.0
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.08 $\mu\mu$fd
Input	10.5 $\mu\mu$fd
Output	4.7 $\mu\mu$fd
Transconductance (I_b=50ma., E_b=2500v., E_{c2}=500v., E_{c3}= 0v.)	2150 μmhos
Highest Frequencies for Maximum Ratings	75 Mc.

MECHANICAL

Base	7-pin, metal shell
Connections	See drawing
Socket*	E. F. Johnson Co. No. 122-237, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Recommended Heat Dissipating Plate Connector	Eimac HR-5
Maximum Over-All Dimensions:	
Length	6.19 inches
Diameter	2.75 inches
Net Weight (Average)	6.0 ounces
Shipping Weight	2.0 pounds

*See "Cooling" under Application Notes.

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to specified plate current, maintaining fixed conditions of grid bias, screen voltage and suppressor voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid, screen and suppressor currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony, Frequencies up to 75 Mc.
(Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C GRID VOLTAGE	−500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SUPPRESSOR DISSIPATION	20 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
60 Suppressor Volts, 500 Screen Volts

D-C Plate Voltage	1000	1500	2000	2500	3000	volts
D-C Grid Voltage	−120	−130	−150	−170	−200	volts
D-C Plate Current	167	200	200	186	167	ma
D-C Suppressor Current*	6	5	4	3	3	ma
D-C Screen Current*	11	11	11	7	5	ma
D-C Grid Current*	6	8	8	7	6	ma
Peak R-F Grid Input Voltage	170	200	222	240	260	volts
Driving Power*	1.0	1.6	1.8	1.7	1.6	watts
Grid Dissipation*	.3	.6	.6	.5	.6	watts
Screen Dissipation*	5.5	5.5	5.5	3.5	2.5	watts
Plate Dissipation	47	85	100	115	125	watts
Plate Power Input	167	300	400	465	500	watts
Plate Power Output	120	215	300	350	375	watts

TYPICAL OPERATION
Zero Suppressor Volts, 500 Screen Volts

D-C Plate Voltage	1000	1500	2000	2500	3000	volts
D-C Grid Voltage	−120	−130	−150	−170	−200	volts
D-C Plate Current	145	180	200	184	167	ma
D-C Screen Current*	17	20	23	18	12	ma
D-C Grid Current*	6	8	11	9	7	ma
Peak R-F Grid Input Voltage	170	200	240	250	270	volts
Driving Power*	1.0	1.6	2.6	2.3	1.9	watts
Grid Dissipation*	.3	.6	1.0	.8	.5	watts
Screen Dissipation*	8.5	10	12	9	6	watts
Plate Dissipation	55	95	125	125	125	watts
Plate Power Input	145	270	400	460	500	watts
Plate Power Output	90	175	275	335	375	watts

TYPICAL OPERATION
Zero Suppressor Volts, 750 Screen Volts

D-C Plate Voltage	1000	1500	2000	2500	3000	volts
D-C Grid Voltage	−170	−180	−200	−225	−250	volts
D-C Plate Current	160	200	200	186	167	ma
D-C Screen Current*	21	24	22	12	9	ma
D-C Grid Current*	3	6	6	4	3	ma
Peak R-F Grid Input Voltage	205	235	257	270	290	volts
Driving Power*	.6	1.4	1.5	1.1	.9	watts
Grid Dissipation*	.1	.4	.3	.2	.2	watts
Screen Dissipation*	16	18	17	9	7	watts
Plate Dissipation	45	85	100	115	125	watts
Plate Power Input	160	300	400	465	500	watts
Plate Power Output	115	215	300	350	375	watts

*Approximate Values

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Supersedes Sheet Dated 12-1-49

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony, Frequencies up to 75 Mc.
(Carrier conditions, per tube, unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3200 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C GRID VOLTAGE	−500 MAX. VOLTS
D-C PLATE CURRENT	160 MAX. MA
PLATE DISSIPATION	85 MAX. WATTS
SUPPRESSOR DISSIPATION	20 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
Zero Suppressor Volts, 500 Screen Volts

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Grid Voltage	−190	−195	−200	−205	volts
D-C Plate Current	149	150	151	152	ma
D-C Screen Current*	20	18	17	16	ma
D-C Grid Current*	7	7	8	8	ma
Peak A-F Screen Voltage (100% Modulation)	350	350	350	350	volts
Peak R-F Grid Input Voltage	260	265	270	275	volts
Driving Power*	2	2	2	2	watts
Grid Dissipation*	0.5	0.5	0.5	0.5	watts
Screen Dissipation*	10	9	8.5	8	watts
Plate Dissipation	64	72	80	85	watts
Plate Power Input	149	225	300	380	watts
Plate Power Output	85	153	220	295	watts

SUPPRESSOR-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony, Frequencies up to 75 Mc.
(Carrier conditions, per tube, unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C GRID VOLTAGE	−500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SUPPRESSOR DISSIPATION	20 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1500	2000	2500	3000	volts
D-C Suppressor Voltage	−220	−260	−305	−350	volts
Peak A-F Suppressor Voltage (100% Modulation)	220	260	305	350	volts
D-C Screen Voltage	400	400	400	400	volts
Fixed D-C Screen Voltage	610	645	650	610	volts
Screen Dropping Resistor[1]	5500	7100	10,000	8300	ohms
D-C Grid Voltage	−170	−180	−190	−200	volts
D-C Plate Current	59	59	59	60	ma
D-C Screen Current*	38	27	25	25	ma
D-C Grid Current*	6	5	5	4	ma
Peak R-F Grid Input Voltage	230	235	245	250	volts
Driving Power*	1.4	1.3	1.2	1.2	watts
Grid Dissipation*	.35	.25	.25	.20	watts
Screen Dissipation*	15	11	10	10	watts
Plate Dissipation	54	68	87	105	watts
Plate Power Input	89	118	148	180	watts
Plate Power Output	35	50	61	75	watts

[1]Adjust to stated d-c screen voltage.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB, Sinusoidal Wave

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C GRID VOLTAGE	−500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SUPPRESSOR DISSIPATION	20 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION (Two tubes unless otherwise specified)
Class-AB_1

D-C Plate Voltage	1500	2000	2500	volts
D-C Suppressor Voltage	0	0	0	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage[1]	−70	−80	−85	volts
Zero-Signal D-C Plate Current	110	85	65	ma
Max-Signal D-C Plate Current	205	210	220	ma
Zero-Signal D-C Screen Current*	0	0	0	ma
Max-Signal D-C Screen Current*	15	13	8	ma
Effective Plate-to-Plate Load	13,700	18,000	20,000	ohms
Peak A-F Grid Voltage (per tube)	70	80	85	volts
Max-Signal Driving Power*	0	0	0	watts
Max-Signal Plate Power Input	310	420	550	watts
Max-Signal Plate Power Output	200	250	300	watts

[1]Adjust to stated zero-signal d-c plate current. The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

TYPICAL OPERATION (Two tubes unless otherwise specified)
Class-AB_2

D-C Plate Voltage	1500	2000	2500	volts
D-C Suppressor Voltage	60	0	0	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage[1]	−70	−80	−85	volts
Zero-Signal D-C Plate Current	110	85	65	ma
Max-Signal D-C Plate Current	365	295	250	ma
Zero-Signal D-C Screen Current*	0	0	0	ma
Max-Signal D-C Screen Current*	11	16	13	ma
Effective Plate-to-Plate Load	7300	13,000	20,000	ohms
Peak A-F Grid Input Voltage (per tube)	100	100	95	volts
Max-Signal Driving Power*	0.5	0.3	0.2	watts
Max-Signal Plate Power Input	550	590	625	watts
Max-Signal Plate Power Output	300	350	400	watts

[1]Adjust to stated zero-signal d-c plate current.
*Approximate values.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting—The 4E27A/5-125B must be mounted vertically, base down or up. The plate lead should be flexible, and the tube must be protected from vibration and shock.

Cooling—A heat dissipating connector (Eimac HR-5 or equivalent) is required at the plate terminal, and provision must be made for the free circulation of air through the socket and through the holes in the base. If the E. F Johnson Co. 122-237 socket recommended under "General Characteristics" is to be used, the model incorporating a ventilating hole should be specified.

At high ambient temperatures, at frequencies above 75 Mc., or when the flow of air is restricted, it may become necessary to provide forced air circulation in sufficient quantity to prevent the temperature of the plate and base seals from exceeding 225°C. Forced movement of air across the tube seals and envelope is always beneficial, though not necessarily required.

Tube temperatures may be measured with the aid of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N. Y.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the base pins, should be the rated value of 5.0 volts. Variations should be held within the range of 4.75 to 5.25 volts.

Grid Voltage—Although a maximum of —500 volts bias may be applied to the grid, there is little advantage in using bias voltages in excess of those listed under "Typical Operation," except in certain specialized applications.

When grid-leak bias is used, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired value from tube to tube.

In class-C operation, particularly at high frequency, both grid bias and grid drive should be only great enough to provide satisfactory operation at good plate efficiency.

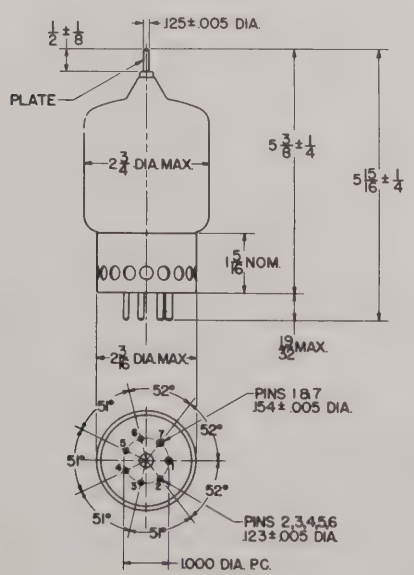
Screen Dissipation—Decrease or removal of plate load, plate voltage or bias voltage may result in screen dissipation in excess of the 20 watt maximum rating. The tube may be protected by an overload relay in the screen circuit set to remove the screen voltage when the dissipation exceeds 20 watts.

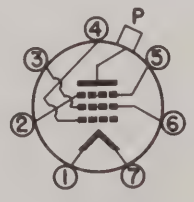
Resistors placed in the screen circuit for the purpose of developing an audio modulating voltage on the screen in modulated radio-frequency amplifiers should be made variable to permit adjustment when replacing tubes.

Plate Dissipation—Plate dissipation in excess of the 125-watt maximum rating is permissible for short periods of time, such as during tuning procedures.

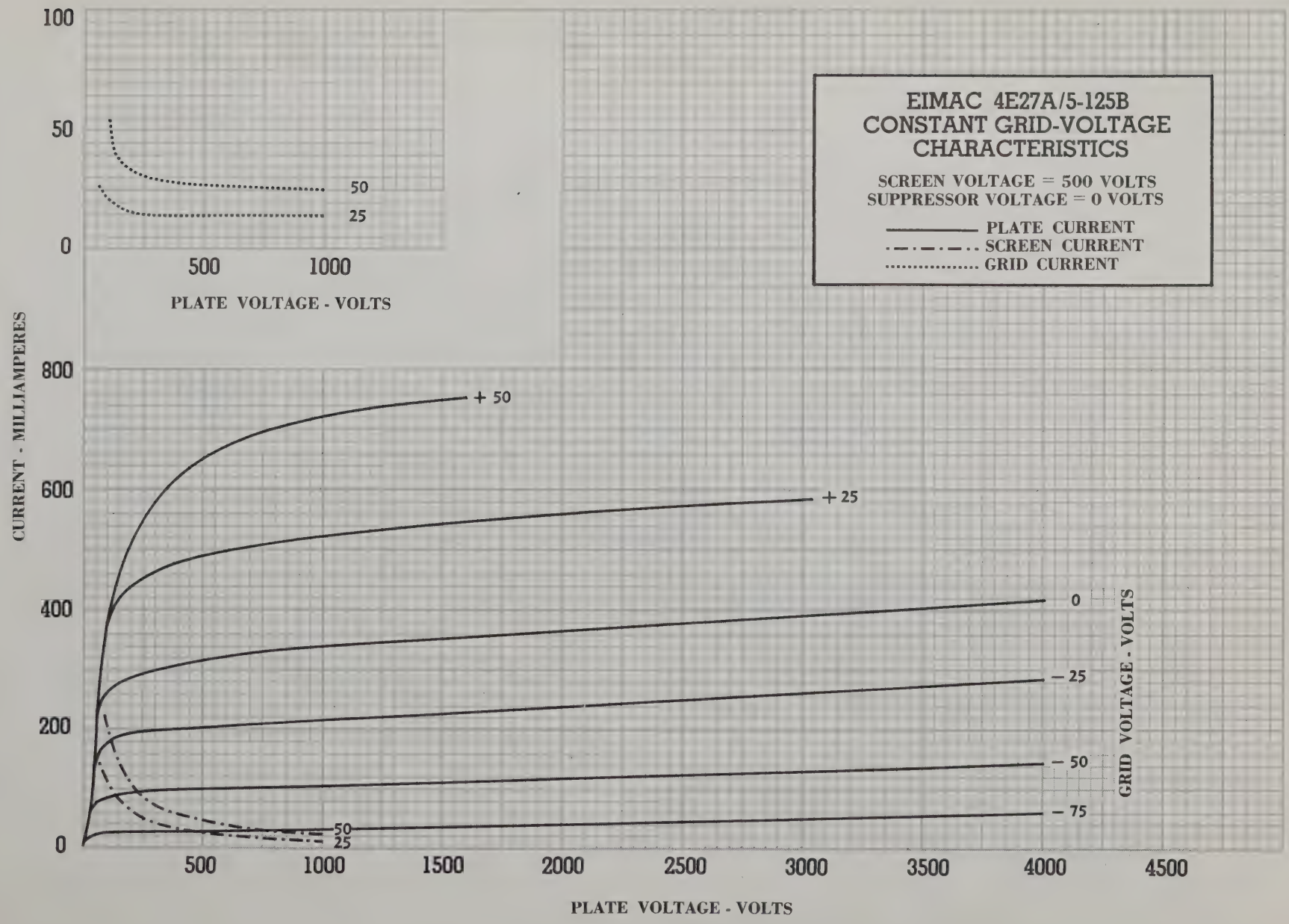
Operation—If reasonable precautions are taken to prevent coupling between the input and output circuits, the 4E27A/5-125B may usually be operated at frequencies up to 75 Mc. without neutralization. A conventional method of obtaining the necessary shielding between the grid and plate circuits is to use a suitable metal chassis with the grid circuit mounted below the deck and the plate circuit above. The tube socket should be mounted flush with the under side of the chassis deck, and spring fingers mounted around the socket opening should make contact between the chassis and the metal base shell of the tube. Power-supply leads entering the amplifier should be by-passed to ground and properly shielded. The output circuit and antenna feeders should be arranged so as to preclude any possibility of feedback to other circuits.

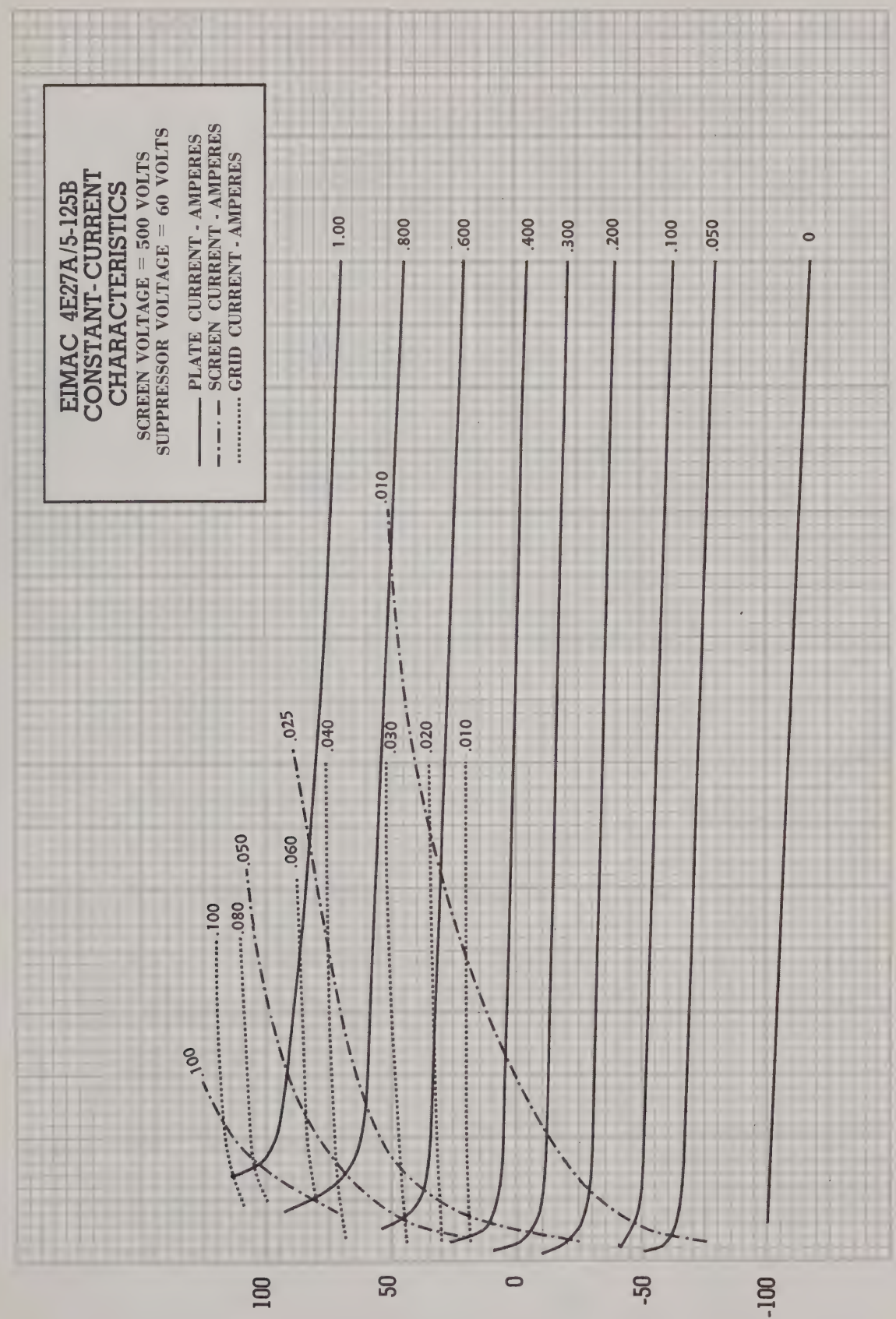
Feedback at high frequencies may be due to the inductance of leads, particularly those of the screen and suppressor-grids. By-passing methods and means of placing these grids at r-f ground potential are discussed in Application Bulletin Number Eight, "The Care and Feeding of Power Tetrodes," available from Eitel-McCullough, Inc. Much of the material contained in this bulletin may be applied to pentodes.

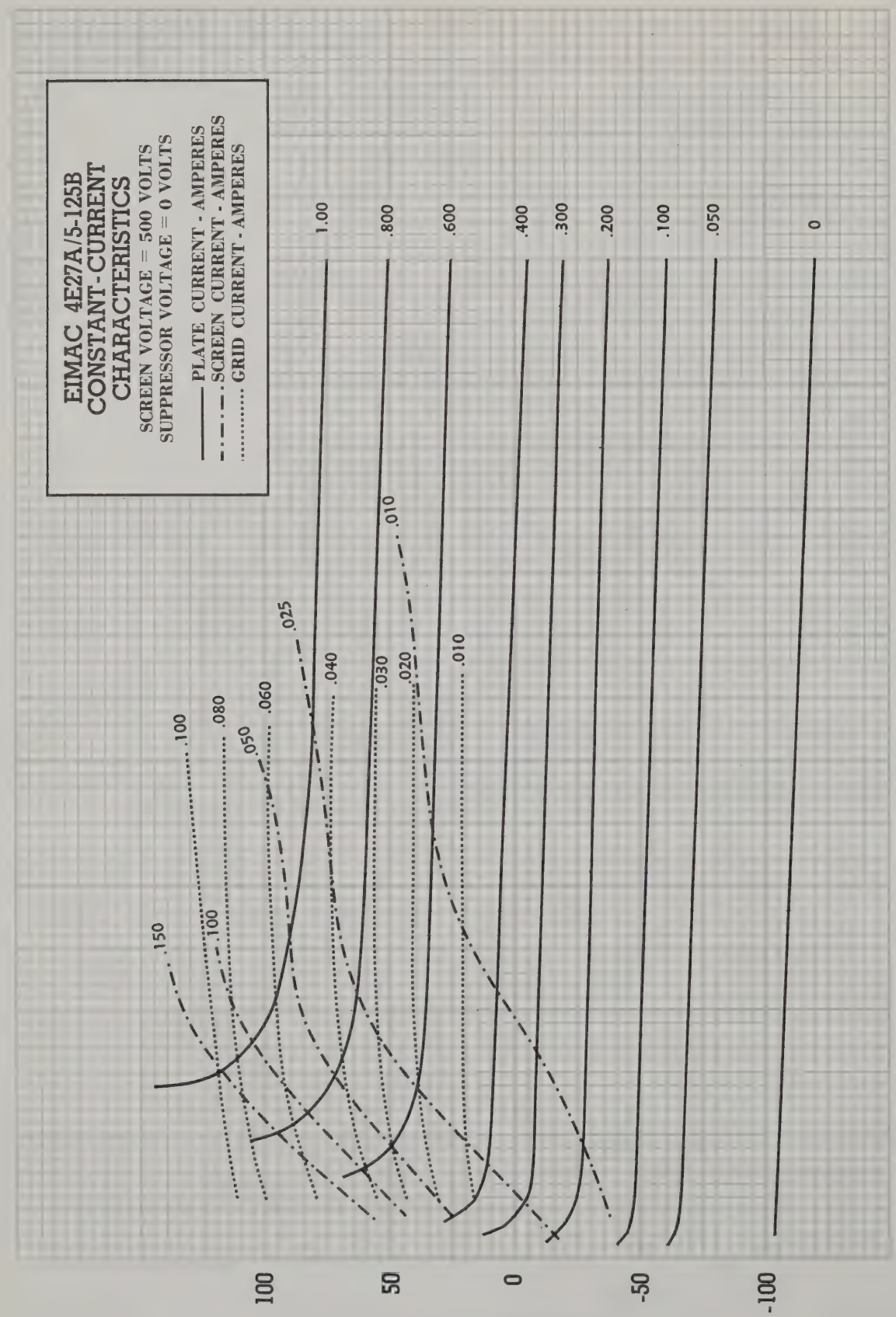




7BM


EIMAC 4E27A/5-125B
CONSTANT GRID-VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
CURRENT - MILLIAMPERES
PLATE VOLTAGE - VOLTS
GRID VOLTAGE - VOLTS
+ 50
+ 25
0
– 25
– 50
– 75
50
25
100
50
0
500
1000
800
600
400
200
0
1500
2000
2500
3000
3500
4000
4500


EIMAC 4E27A/5-125B
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
SUPPRESSOR VOLTAGE = 60 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
1.00
.800
.600
.400
.300
.200
.100
.050
0
.010
.100
.080
.050
.060
.025
.040
.030
.020
.010
100
50
0
-50
-100
0
500
1000
1500
2000
2500
3000
3500
4000
4500
GRID VOLTAGE - VOLTS
PLATE VOLTAGE - VOLTS



Printed in U.S.A. 712

TECHNICAL DATA

5CX1500A

RADIAL BEAM
POWER PENTODE

The EIMAC 5CX1500A is a ceramic/metal power pentode designed for use as a Class AB_1 linear amplifier in audio or radio frequency applications. Its characteristic low intermodulation distortion makes it especially suitable for single sideband service. The filament is a rugged mesh type.

The tube is also recommended for use as a Class C rf power amplifier in CW, FM and AM service.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 ± 0.25 V
Current, at 5.0 volts	40 A
Transconductance (Average):	
I_b = 1.0 Adc, E_{c2} = 500 Vdc	24,000 μmhos
Amplification Factor (Average):	
Grid to Screen	5.5
Direct Interelectrode Capacitance (grounded cathode)[2]	
Input	75 pF
Output	16.5 pF
Feedback	0.20 pF
Frequency of Maximum Rating:	
CW	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. Capacitance values are for a cold tube as measured in a special shielded fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	4.950 in; 125.73 mm
Diameter	3.370 in; 85.60 mm
Net Weight	30 oz; 850.5 gm
Operating Position	Axis vertical, base down or up
Maximum Operating Temperature:	
Ceramic/Metal Seals	250°C
Anode Core	250°C

(Effective 6-6-70) © 1965,1967,1970 Varian Printed in U.S.A.

Cooling	Forced Air
Base	Special ring and breechblock terminal surfaces
Recommended Air System Socket	EIMAC SK-840 series
Recommended (Air) Chimney	EIMAC SK-806

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB_1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	750	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
SUPPRESSOR DISSIPATION	25	WATTS
SCREEN DISSIPATION	75	WATTS
GRID DISSIPATION	25	WATTS

1. Adjust to specified zero-signal dc plate current.
2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.
3. Approximate values.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	2500	3000	4000	Vdc
Suppressor Voltage	0	0	0	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage[1]	-87	-89	-90	Vdc
Zero-Signal Plate Current	250	250	250	mAdc
Single-Tone Plate Current	660	690	690	mAdc
Two-Tone Plate Current	470	480	485	mAdc
Single-Tone Screen Current[3]	79	71	59	mAdc
Two-Tone Screen Current[3]	36	32	25	mAdc
Peak rf Grid Voltage[3]	87	89	90	v
Peak Driving Power[3]	0	0	0	w
Single-Tone Useful Output Power	1090	1330	1785	W
Resonant Load Impedance	2340	2680	3500	Ω
Intermodulation Distortion Products[2]				
3rd Order	-38	-36	-33	db
5th Order	-39	-41	-42	db

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR Class C Telegraphy or FM Telephony

(Key-Down Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	5000	VOLTS
DC SCREEN VOLTAGE	750	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
SUPPRESSOR DISSIPATION	25	WATTS
SCREEN DISSIPATION	75	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	3000	4000	4500	Vdc
Suppressor Voltage	0	0	0	Vdc
Screen Voltage	500	500	500	Vdc
Grid Voltage	-200	-200	-200	Vdc
Plate Current	900	800	900	mAdc
Screen Current[1]	94	66	88	mAdc
Grid Current[1]	35	25	34	mAdc
Peak rf Grid Voltage[1]	255	245	255	v
Calculated Driving Power	9.0	6.5	9.0	W
Plate Input Power	2700	3200	4050	W
Plate Dissipation	720	850	870	W
Plate Output Power	1980	2350	3180	W
Resonant Load Impedance	1570	2240	2520	Ω

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN Class C Telephony

(Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	3500	VOLTS
DC SCREEN VOLTAGE	550	VOLTS
DC PLATE CURRENT	0.8	AMPERE
PLATE DISSIPATION[1]	1000	WATTS
SUPPRESSOR DISSIPATION	25	WATTS
SCREEN DISSIPATION[2]	75	WATTS
GRID DISSIPATION[2]	25	WATTS

1. Corresponds to 1500 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 30 MHz)

Plate Voltage	2500	3200	Vdc
Suppressor Voltage	0	0	Vdc
Screen Voltage	500	500	Vdc
Grid Voltage	-260	-260	Vdc
Plate Current	800	800	mAdc
Screen Current[1]	90	86	mAdc
Grid Current[1]	32	32	mAdc
Peak af Screen Voltage[1] (100% modulation)	500	500	v
Peak rf Grid Voltage[1]	315	315	v
Calculated Driving Power	10	10	W
Plate Input Power	2000	2560	W
Plate Dissipation	530	576	W
Plate Output Power	1470	1958	W
Resonant Load Impedance	1360	1863	Ω

1. Approximate value.

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven (Sinusoidal Wave)

ABSOLUTE MAXIMUM RATINGS (per tube)

DC PLATE VOLTAGE	4000	VOLTS
DC SCREEN VOLTAGE	750	VOLTS
DC PLATE CURRENT	1.0	AMPERE
PLATE DISSIPATION	1500	WATTS
SUPPRESSOR DISSIPATION	25	WATTS
SCREEN DISSIPATION	75	WATTS
GRID DISSIPATION	25	WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	2800	3800	Vdc
Suppressor Voltage	0	0	Vdc
Screen Voltage	500	500	Vdc
Grid Voltage	-81	-83	Vdc
Zero-Signal Plate Current	0.50	1.50	Adc
Max. Signal Plate Current	1.30	1.33	Adc
Zero-Signal Plate Current	20	20	mAdc
Max. Signal Screen Current	110	106	mAdc
Peak af Grid Voltage	81	83	v
Peak Driving Power	0	0	w
Max. Signal Plate Dissipation	720	1130	W
Plate Output Power	2200	3220	W
Load Resistance(plate to plate)	4800	6720	Ω

1. Approximate value.
2. Per tube .
3. Nominal drive power is one-half peak power.
4. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. In the case of Class C Service, if grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Filament: Current at 5.0 volts	38	43	A
Interelectrode Capacitances[1] (grounded cathode connection)			
Input	70	80	pF
Output	14.5	18.5	pF
Feedback	---	0.25	pF
Interelectrode Capacitances[1] (grounded grid connection)			
Input	32	37	pF
Output	14.5	18.5	pF
Feedback	---	0.05	pF

APPLICATION

MECHANICAL

MOUNTING - The 5CX1500A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC SK-840 socket and SK-806 chimney have been designed especially for the 5CX1500A. The use of recommended air-flow rates through these sockets provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through the Air Chimney, and exits through the anode cooling fins.

COOLING - The maximum temperature rating for the anode core of the 5CX1500A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

	SEA LEVEL		6000 FEET	
PLATE DISSIPATION (WATTS)	AIR FLOW (CFM)	PRESSURE DROP (INCHES of WATER)	AIR FLOW (CFM)	PRESSURE DROP (INCHES of WATER)
1000	27	.33	33	.40
1500	47	.76	58	.95

* Since the power dissipated by the filament represents about 200 watts and since grid-plus-screen-plus-suppressor dissipation can, under some conditions, represent another 125 watts, allowance has been made in preparing this tabulation for an additional 325 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

FILAMENT OPERATION - The rated filament voltage for the 5CX1500A is 5.0 volts. Filament voltage, as measured at the socket, should be maintained within ±5% of this value or below to obtain maximum tube life.

INTERMODULATION DISTORTION - The Radio Frequency Linear Amplifier operating conditions including distortion data are the results of operation in a neutralized, grid-driven amplifier. Plots of IM distortion versus power output under two-tone condition for a typical tube are shown on next page.

GRID OPERATION - The rated dissipation of the grid is 25 watts. This is approximately the product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

SCREEN OPERATION - The power dissipated by the screen of the 5CX1500A must not exceed 75 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon rms screen current and voltage.

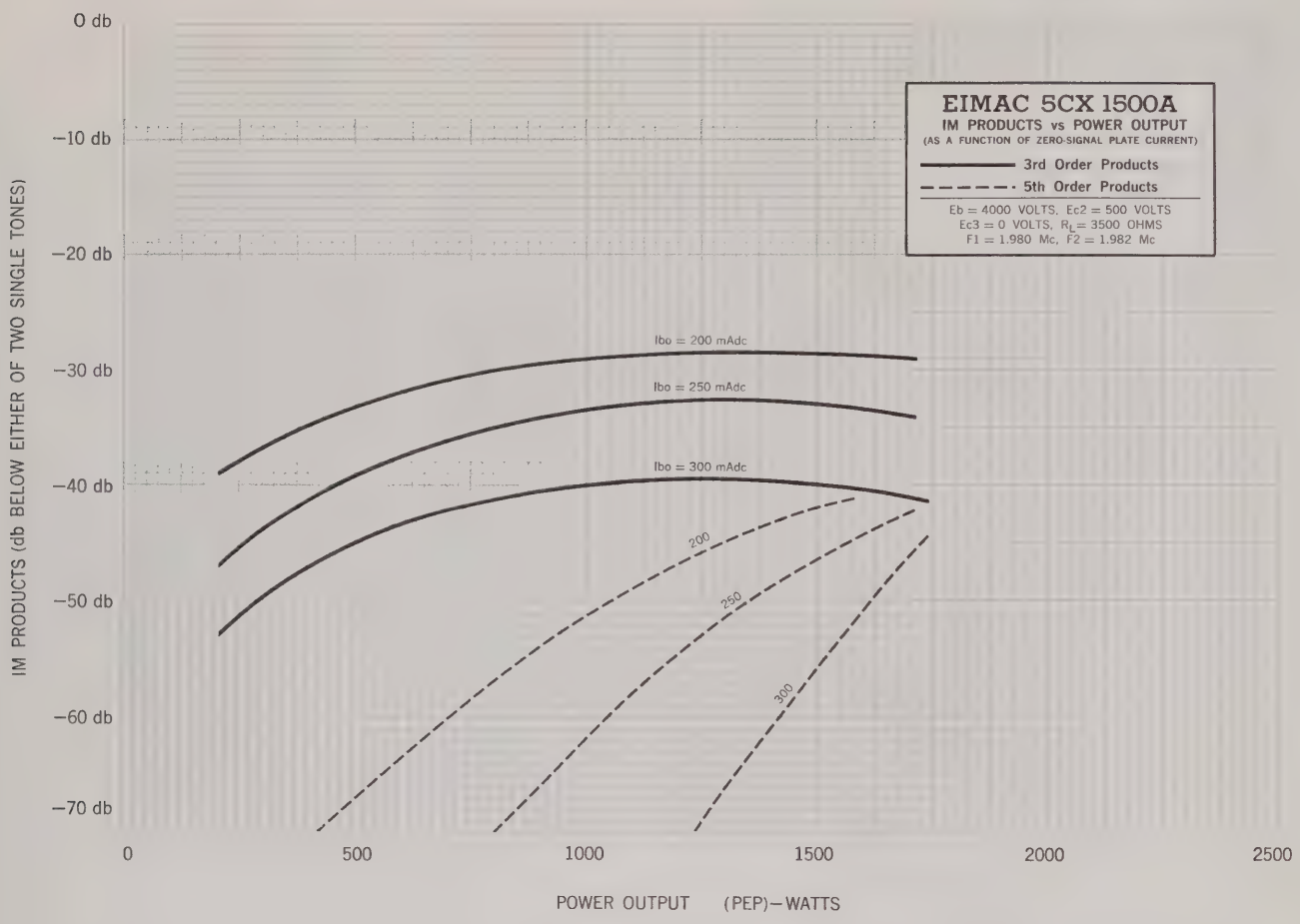
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 75 watts in the event of circuit failure.

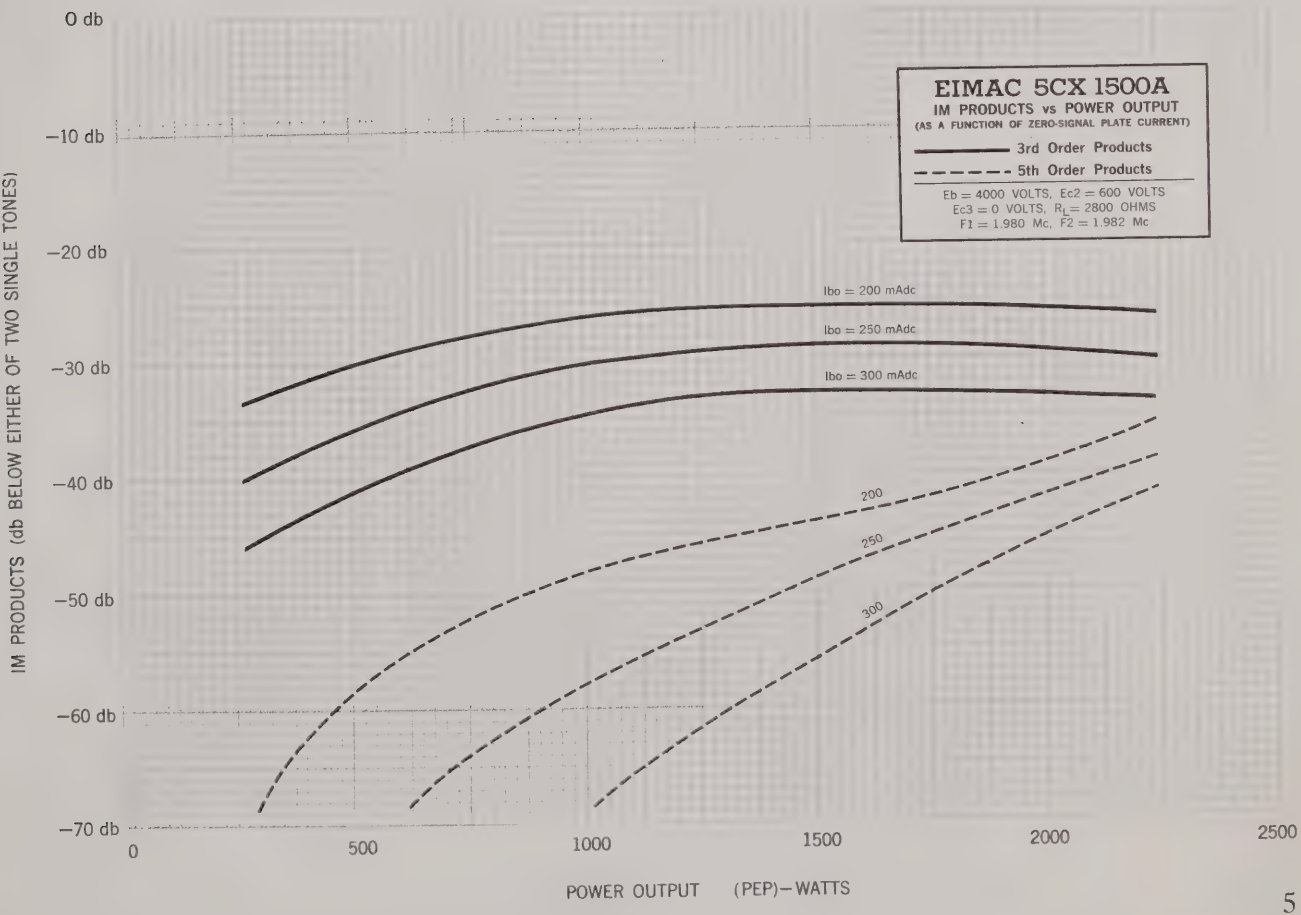
SUPPRESSOR OPERATION - The rated dissipation of the suppressor is 25 watts. Suppressor current will be zero or very nearly zero for all typical operating conditions specified. The 5CX1500A has been designed for zero voltage operation of the suppressor grid for most applications.

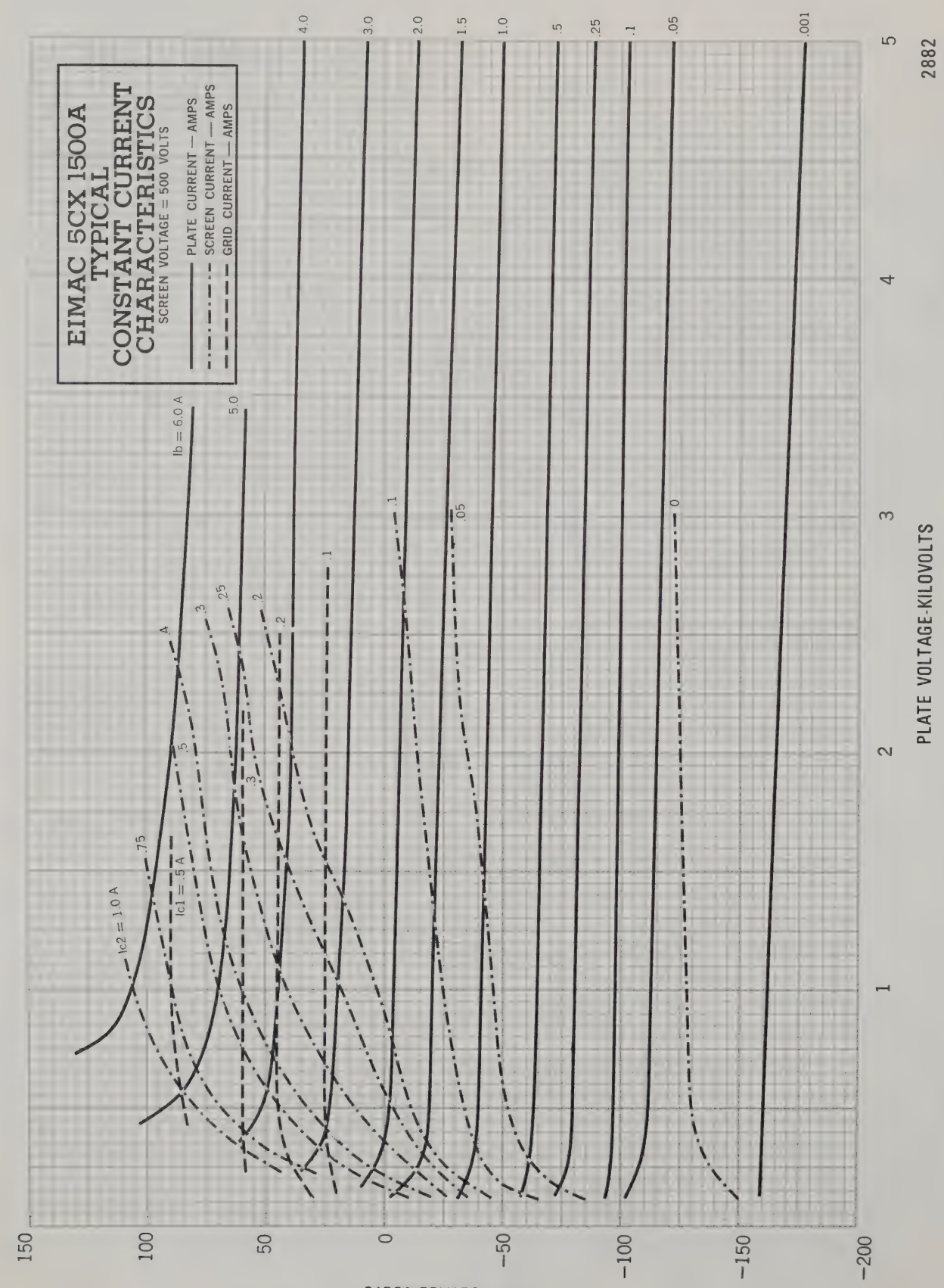
PLATE DISSIPATION - The plate-dissipation ratings for the 5CX1500A is 1000 watts for Class-C plate-modulated service and 1500 watts for Class-C telegraphy. In Class-AB service the plate dissipation rating is 1500 watts.

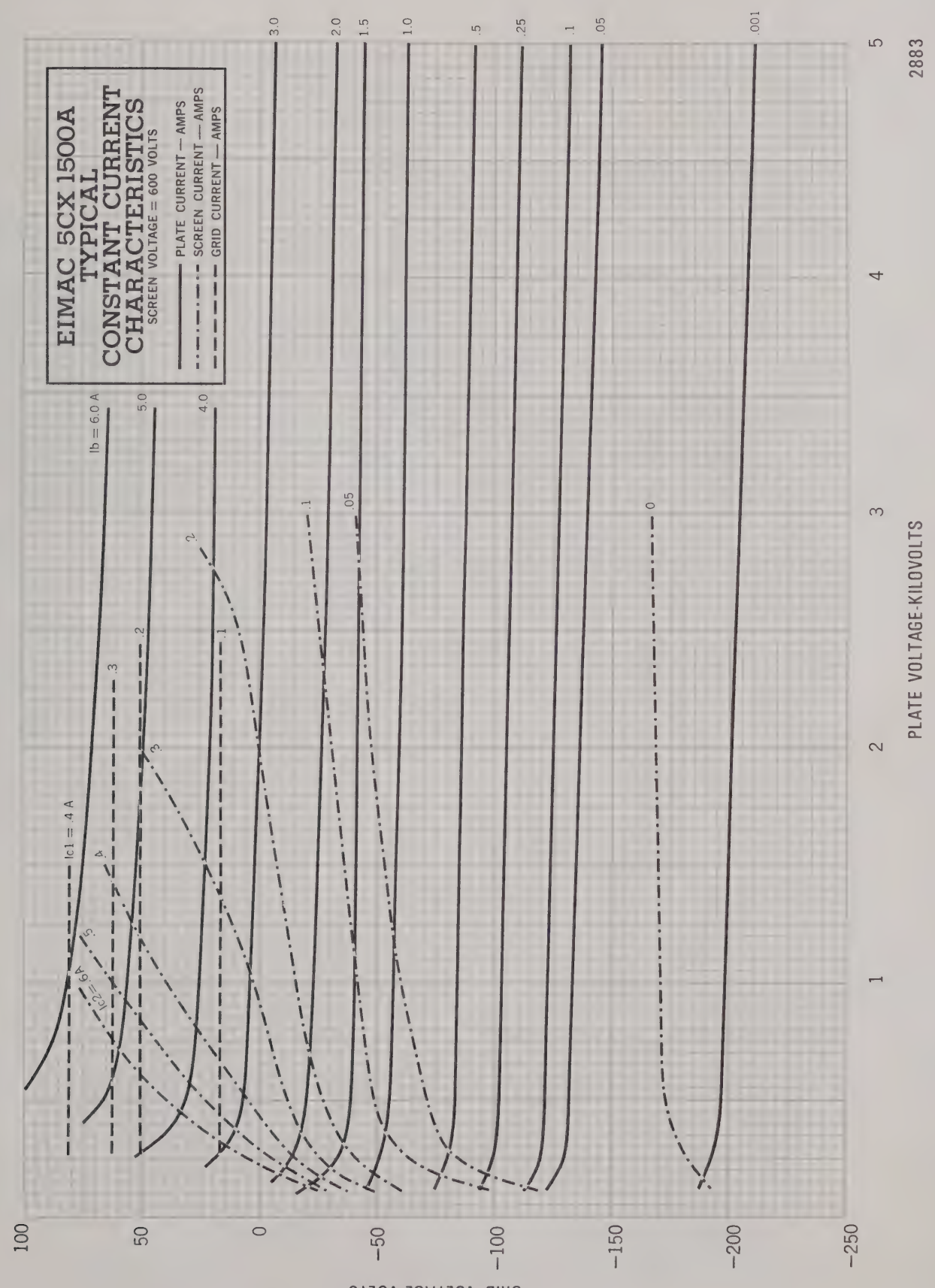
HIGH VOLTAGE - The 5CX1500A operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies and to discharge high voltage condensers whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that HIGH VOLTAGE CAN KILL.

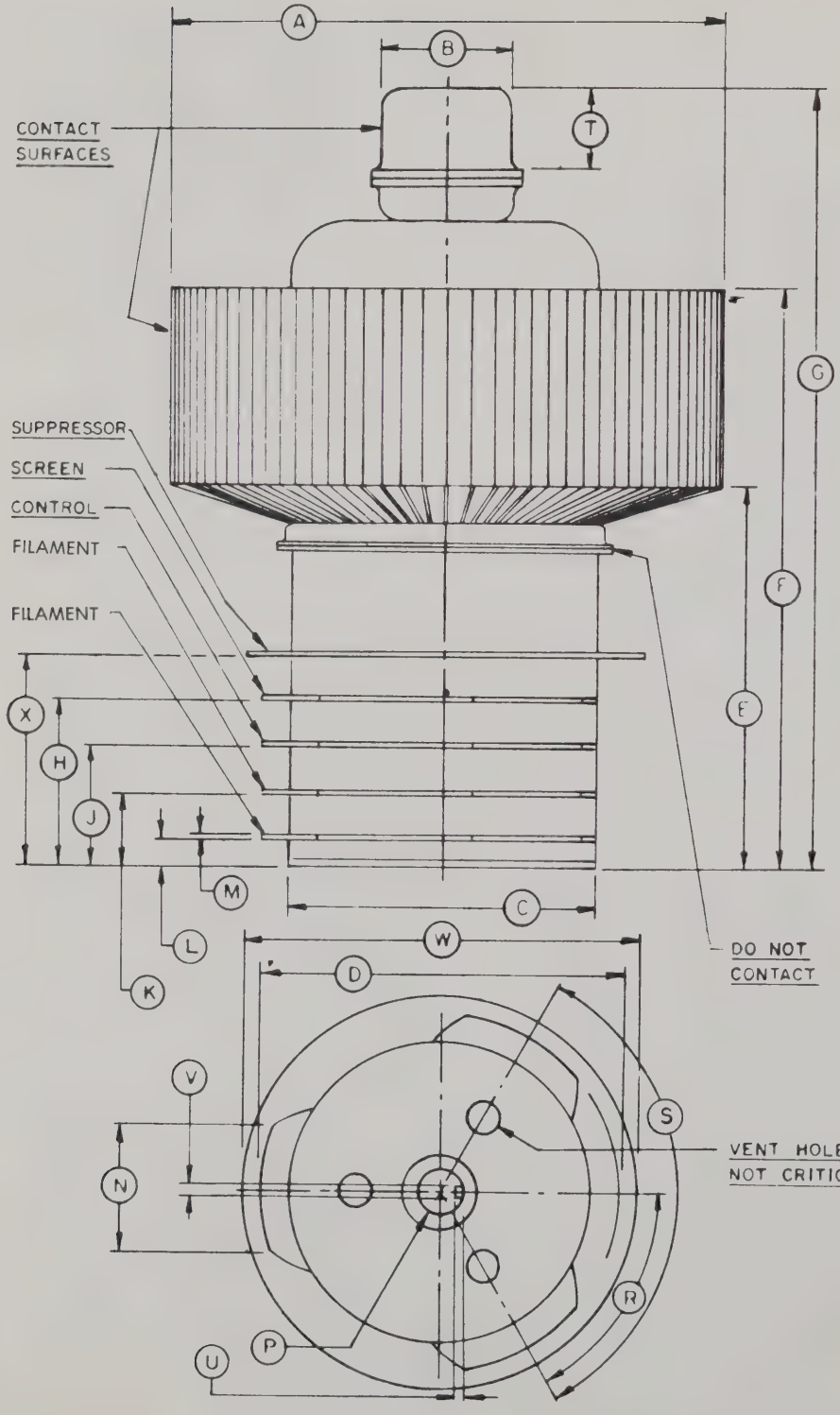
SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here write to the Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.


EIMAC 5CX 1500A
IM PRODUCTS vs POWER OUTPUT
(AS A FUNCTION OF ZERO-SIGNAL PLATE CURRENT)
3rd Order Products
5th Order Products
Eb = 4000 VOLTS, Ec2 = 500 VOLTS
Ec3 = 0 VOLTS, RL = 3500 OHMS
F1 = 1.980 Mc, F2 = 1.982 Mc
Ibo = 200 mAdc
Ibo = 250 mAdc
Ibo = 300 mAdc
200
250
300
0 db
−10 db
−20 db
−30 db
−40 db
−50 db
−60 db
−70 db
0
500
1000
1500
2000
2500
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
POWER OUTPUT (PEP)—WATTS


EIMAC 5CX 1500A
IM PRODUCTS vs POWER OUTPUT
(AS A FUNCTION OF ZERO-SIGNAL PLATE CURRENT)
3rd Order Products
5th Order Products
Eb = 4000 VOLTS, Ec2 = 600 VOLTS
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Ibo = 250 mAdc
Ibo = 300 mAdc
200
250
300
0 db
−10 db
−20 db
−30 db
−40 db
−50 db
−60 db
−70 db
0
500
1000
1500
2000
2500
IM PRODUCTS (db BELOW EITHER OF TWO SINGLE TONES)
POWER OUTPUT (PEP)—WATTS


EIMAC 5CX 1500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ib = 6.0 A
Ic2 = 1.0 A
Ic1 = .5 A
5.0
4.0
3.0
2.0
1.5
1.0
.5
.25
.1
.05
.001
.75
.5
.4
.3
.25
.2
.2
.3
.1
.1
.05
0
150
100
50
0
−50
−100
−150
−200
1
2
3
4
5
GRID VOLTAGE-VOLTS
PLATE VOLTAGE-KILOVOLTS
2882


EIMAC 5CX 1500A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 600 VOLTS
PLATE CURRENT — AMPS
SCREEN CURRENT — AMPS
GRID CURRENT — AMPS
Ic1 = .4 A
Ib = 6.0 A
Ic2 = .6 A
5.0
4.0
3.0
2.0
1.5
1.0
.5
.25
.1
.05
.001
.4
.3
.2
.1
.5
.2
.1
.05
0
100
50
0
−50
−100
−150
−200
−250
1
2
3
4
5
GRID VOLTAGE-VOLTS
PLATE VOLTAGE-KILOVOLTS
2883



DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	3.335	3.370	84.71	85.60
B	0.807	0.820	20.50	20.83
C	1.870	1.900	47.50	48.26
D	2.250D	2.300D	57.15D	58.42D
E	2.335	2.535	59.31	64.39
F	3.530	3.730	89.66	94.74
G	4.800	4.950	121.92	125.73
H	0.950	1.000	24.13	25.40
J	0.675	0.725	17.15	18.42
K	0.400	0.450	10.16	11.43
L	0.140	0.170	3.56	4.32
M	0.020	0.030	0.51	0.76
N	0.700	0.800	17.78	20.32
P	0.314D	0.326D	7.98D	8.28D
R	55°	65°	55°	65°
S	115°	125°	115°	125°
T	0.470	0.530	11.94	13.46
U	0.025	0.048	0.63	1.22
V	0.045D	0.070D	1.14D	1.78D
W	2.468	2.531	62.69	64.29
X	1.225	1.275	31.12	32.39

NOTE:
REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES

EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

5CX3000A

RADIAL-BEAM POWER PENTODE

The EIMAC 5CX3000A is a ceramic and metal power pentode designed to be used as a Class-AB$_1$ linear amplifier in audio or radio-frequency applications. Its characteristics of low intermodulation distortion make it especially suitable for single side-band service.



GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		9.0		volts
Current	39.5		43.5	amps
Amplification Factor (Grid Screen)		5.5		
Frequency for Maximum Ratings			150	MHz
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	125		145	pF
Output	18		24	pF
Feedback			.60	pF
Direct Interelectrode Capacitances, Grounded Grid and Screen:				
Input	55		67	pF
Output	18		24	pF

MECHANICAL

Base	Special ring and breechblock terminal surfaces
Maximum Seal Temperature	250°C
Maximum Anode Core Temperature	250°C
Recommended Socket	EIMAC SK-1420 series
Recommended Air Chimney	EIMAC SK-1426
Operating Position	Axis vertical, base up or down
Maximum Dimensions:	
Height	6.8 inches
Diameter	4.6 inches
Cooling	Forced air
Net Weight	5.5 pounds
Shipping Weight (Approximate)	10 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.0 AMPS
PLATE DISSIPATION	4000 WATTS
SCREEN DISSIPATION	175 WATTS
GRID DISSIPATION	50 WATTS
SUPPRESSOR DISSIPATION	100 WATTS

TYPICAL OPERATION

DC Plate Voltage	6800 volts
DC Screen Voltage	500 volts
DC Grid Voltage	–200 volts
Suppressor Grid	0 volts
DC Plate Current	1.64 amps
DC Screen Current	276 mA
DC Grid Current	72 mA
Peak RF Grid Voltage	300 volts
Driving Power	52 watts
Plate Dissipation	2600 watts
Plate Output Power	8500 watts

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Printed in U.S.A.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB

MAXIMUM RATINGS (Per Tube)

DC PLATE VOLTAGE	7000 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.0 AMPS
PLATE DISSIPATION	4000 WATTS
SCREEN DISSIPATION	175 WATTS
GRID DISSIPATION	50 WATTS
SUPPRESSOR GRID	100 WATTS

*Per Tube
**Approximate Values

TYPICAL OPERATION (Two Tubes), Class AB_1

DC Plate Voltage	6000 volts
DC Screen Voltage	850 volts
DC Grid Voltage*	–147 volts
DC Suppressor Grid Voltage	0 volts
Max-Signal Plate Current	2.9 amps
Zero-Signal Plate Current	1.0 amp
Max-Signal Screen Current**	200 mA
Zero-Signal Screen Current	0 mA
Peak AF Driving Voltage*	138 volts
Driving Power	0 watts
Load Resistance, Plate-to-Plate	4700 ohms
Max-Signal Plate Dissipation*	3000 watts
Max-Signal Plate Output Power	11,000 watts

Note: In Class AB operation, maximum plate voltage and plate current must not be applied simultaneously, as plate dissipation will be exceeded.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.0 AMPS
PLATE DISSIPATION	4000 WATTS
SCREEN DISSIPATION	175 WATTS
GRID DISSIPATION	50 WATTS
SUPPRESSOR DISSIPATION	100 WATTS

*Adjust to the specified Zero-Signal Ib
**The intermodultaion distortion products will be as specified or better for all levels from zero-signal to maximum output power and are referenced against one tone of a two equal tone signal.

TYPICAL OPERATION Class AB_1 Grid Driven

DC Plate Voltage	3800	6000 volts
DC Screen Voltage	800	850 volts
DC Grid Voltage*	–128	–147 volts
DC Suppressor Voltage	0	0 volts
Zero-Signal DC Plate Current	.600	.500 amps
Single-Tone DC Plate Current	1.510	1.445 amps
Single-Tone DC Screen Current	.136	.092 mA
Two-Tone DC Plate Current	1.770	1.010 amps
Two-Tone DC Screen Current	.072	.041 mA
Peak RF Grid Voltage	116	128 volts
Peak Envelope Useful Output Power	3300	5500 watts
Resonant Load Impedance	1300	2350 ohms
Intermodulation Distortion Products** (no negative feedback)		
3rd Order	–46	–41 dB
5th Order	–50	–53 dB

Note: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance is made for circuit losses. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed.

APPLICATION

MECHANICAL

Mounting — The 5CX3000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket — The EIMAC SK-1420 socket and SK-1426 chimney have been designed especially for the 5CX3000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through an Air Chimney, the SK-1426, and through the anode cooling fins.

Cooling — The maximum temperature rating for the 5CX3000A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperature at 200°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

Plate Dissipation* (Watts)	SEA LEVEL		5,000 FEET	
	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
2500	67	1.24	80	1.5
3500	100	2.4	121	3.2
4000	117	3.1	140	4.3

***Since the power dissipated by the filament represents about 450 watts and since grid-plus-screen dissipation can, under some conditions, represent another 225 watts, allowance has been made in preparing this tabulation for an additional 675 watts dissipation.**

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation — The rated filament voltage for the 5CX3000A is 9 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than plus or minus five percent from the rated value.

Intermodulation Distortion — The operating conditions including distortion data are the results of actual operation in a neutralized, grid-driven amplifier. A plot of IM distortion versus power output under two-tone condition for a typical tube is shown on the next page.

Control Grid Operation—The rated dissipation of the grid is 50 watts. This is approximately the product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

Screen-Grid Operation—The power dissipated by the screen of the 5CX3000A must not exceed 175 watts.

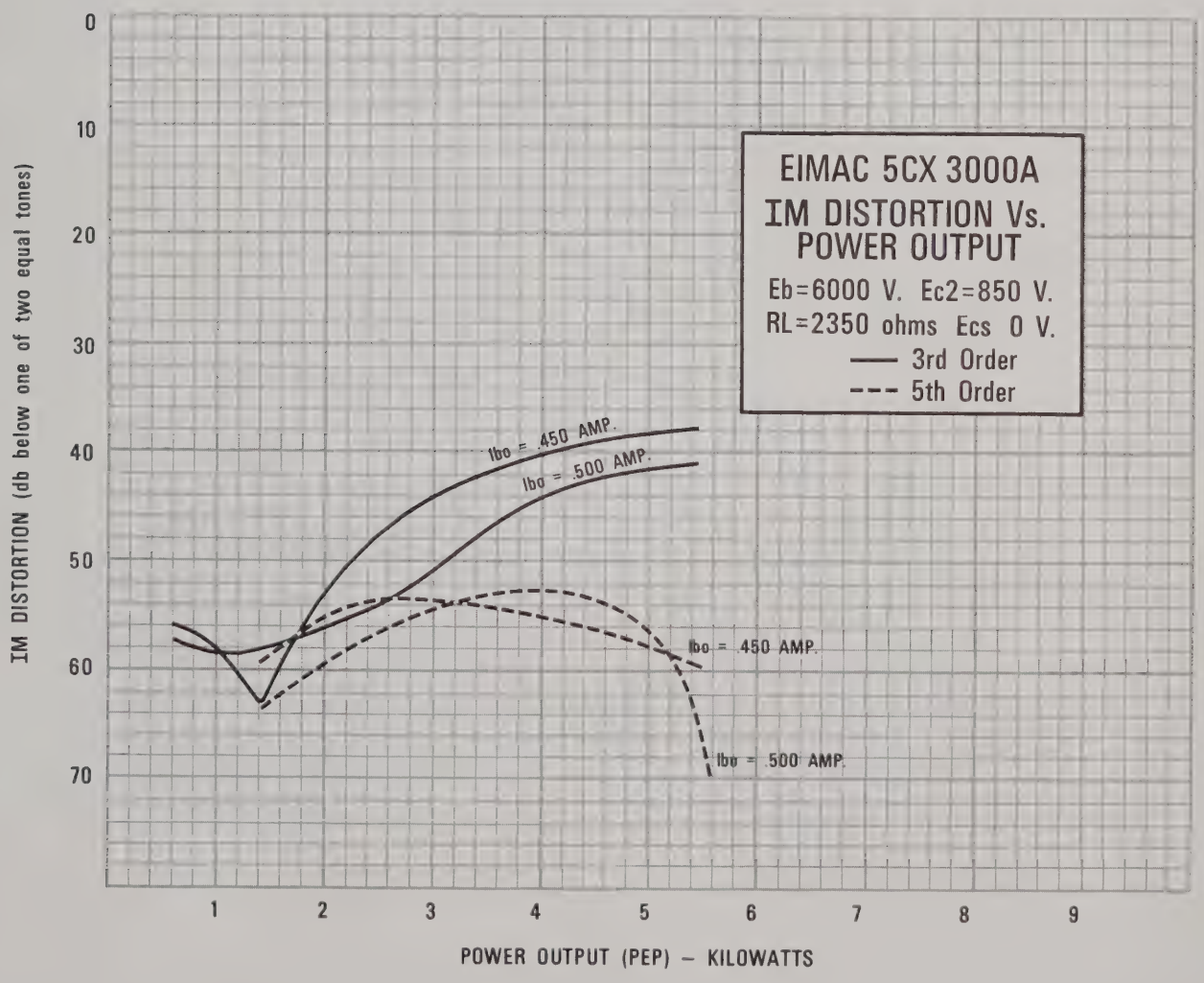
Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

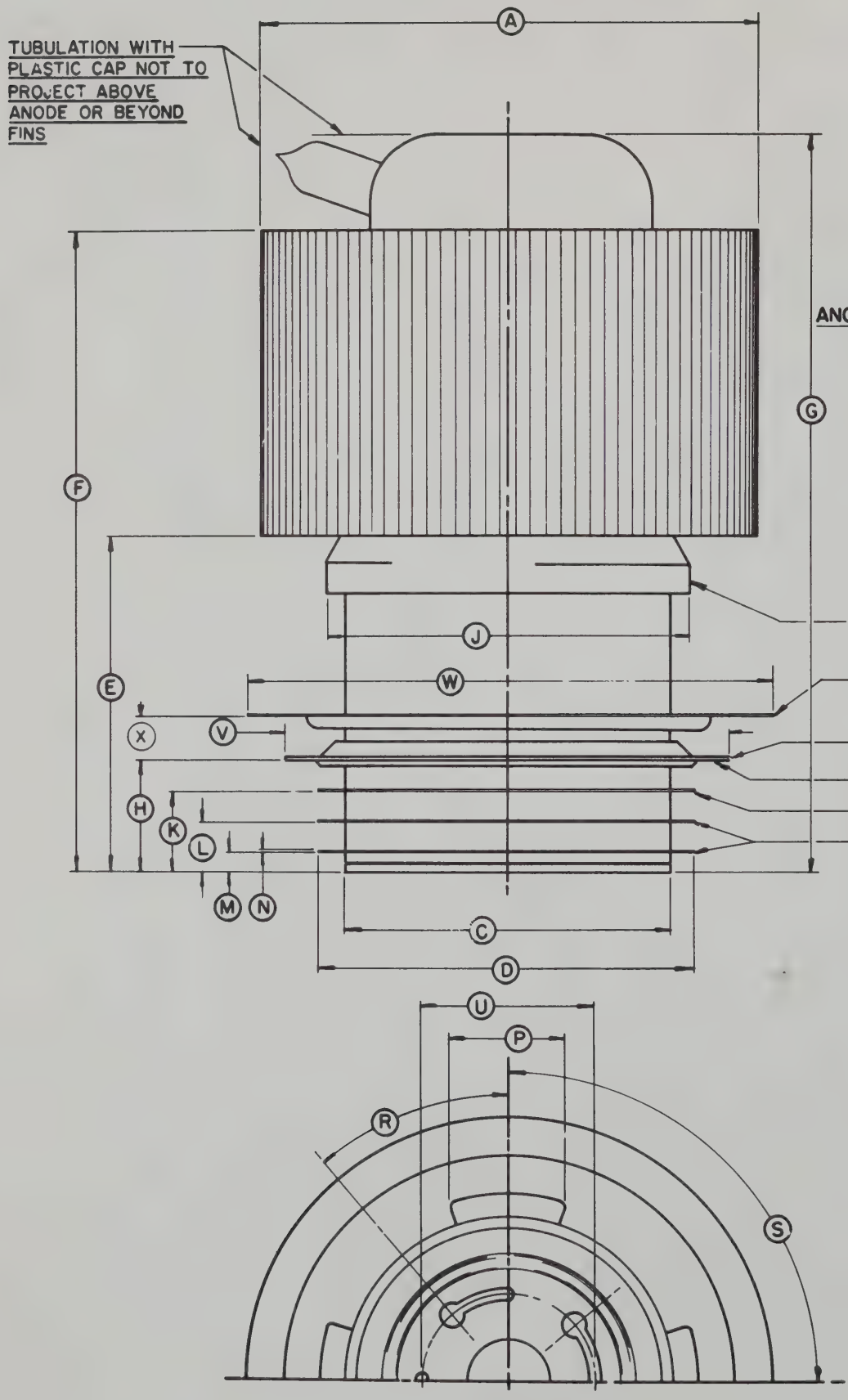
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 175 watts in the event of circuit failure.

Suppressor Grid — The rated dissipation of the suppressor grid is 100 watts. Suppressor current will be zero or very nearly zero for all typical operating conditions specified. The 5CX-3000A has been designed for zero voltage operation of the suppressor grid for most applications.

Plate Dissipation — The plate-dissipation ratings for the 5CX3000A are 2650 watts for Class-C plate-modulated service and 4000 watts for Class-C telegraphy and Class-AB operation. In any Class-AB application maximum plate current and maximum plate voltage should not be applied simultaneously as the plate-dissipation rating would be exceeded.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to the Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

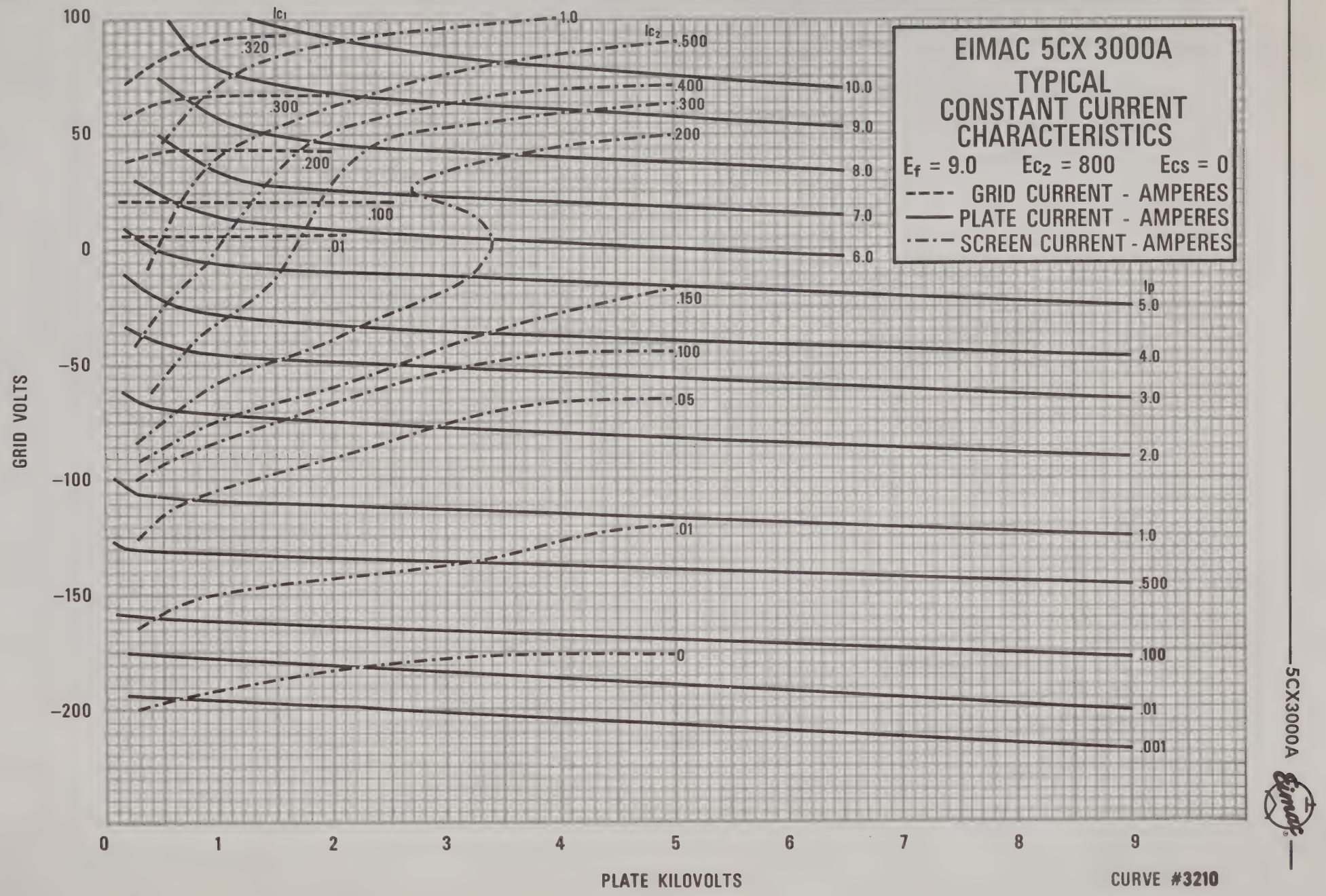


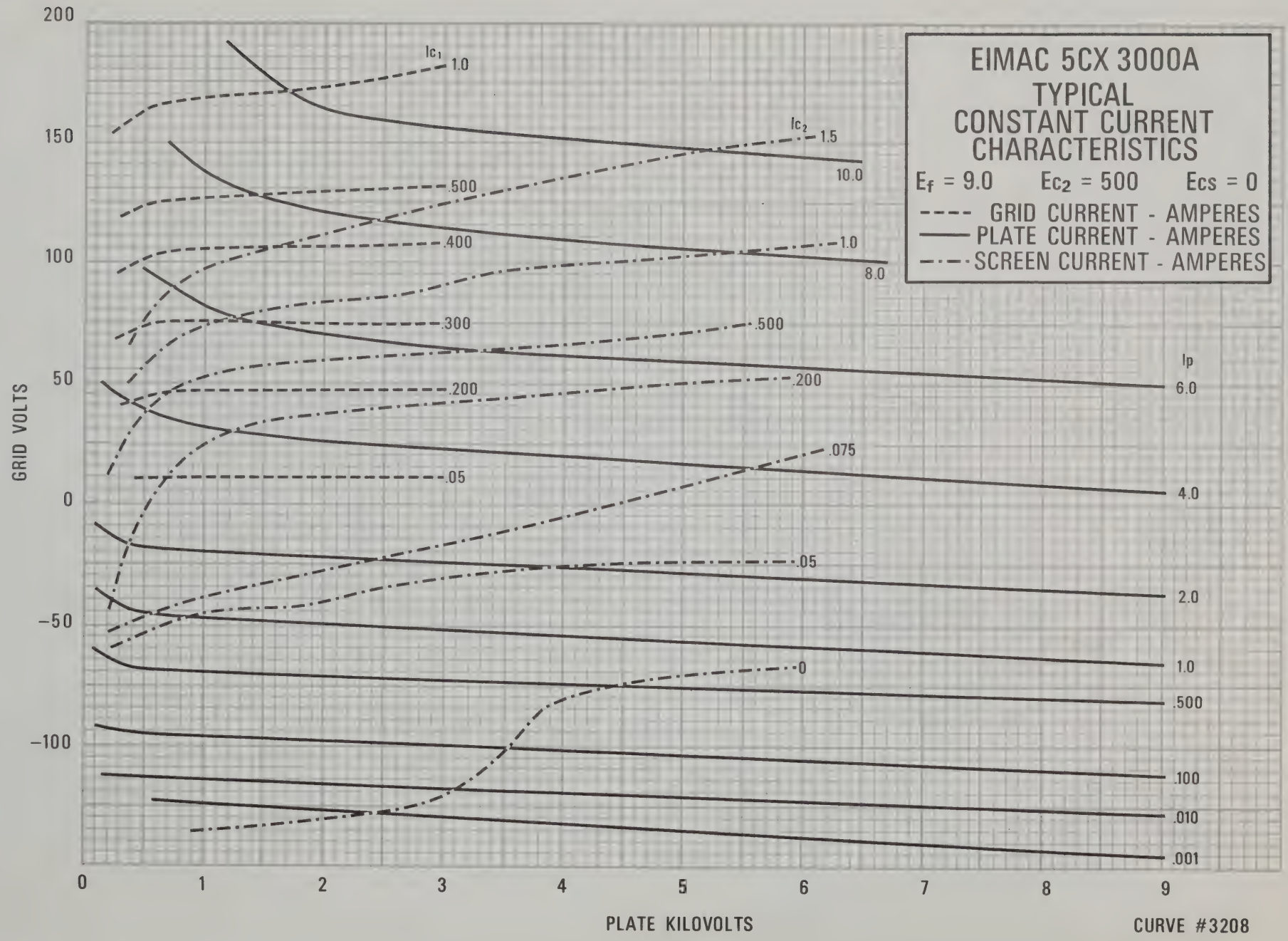


DIMENSIONS IN INCHES

DIMENSIONAL DATA			
DIM.	MIN.	MAX.	REF.
A	4.585	4.625	
C	2.985	3.025	
D	3.490	3.525	
E	3.050	3.150	
F	5.900	6.100	
G	6.638	6.838	
H	.965	1.005	
J	3.380	3.450	
K	.700	.730	
L	.430	.460	
M	.160	.180	
N	.018	.025	
P	1.050	1.100	
R	39°	41°	
S	89°	91°	
U	1.557	1.567	
V	4.000	4.175	
W	4.615	4.635	
X			.375

NOTE 1. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.


EIMAC 5CX 3000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
Ef = 9.0 Ec2 = 800 Ecs = 0
GRID CURRENT - AMPERES
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID VOLTS
PLATE KILOVOLTS
CURVE #3210
Ic1
Ic2
Ip
100
50
0
−50
−100
−150
−200
0
1
2
3
4
5
6
7
8
9
1.0
.500
.400
.300
.200
.150
.100
.05
.01
0
.320
.300
.200
.100
.01
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
.500
.100
.01
.001


EIMAC 5CX 3000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
Ef = 9.0 Ec2 = 500 Ecs = 0
GRID CURRENT - AMPERES
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
Ic1
Ic2
Ip
1.0
1.5
10.0
.500
.400
1.0
8.0
.300
.500
.200
.200
6.0
.075
.05
4.0
.05
2.0
0
1.0
.500
.100
.010
.001
200
150
100
50
0
−50
−100
GRID VOLTS
0
1
2
3
4
5
6
7
8
9
PLATE KILOVOLTS
CURVE #3208

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290

RADIAL BEAM POWER PENTODE

The EIMAC 290 is a ceramic/metal, forced-air cooled, radial beam pentode with a rated maximum plate dissipation of 5000 watts. The tube has very low input capacitance for its power-handling capability. It is well suited for use in broad-band linear amplifiers or other high-performance Class AB1 amplifier applications.



GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	17	A
Transconductance (Average):		
I_b = 2.0 Adc, E_{c2} = 750 Vdc	37,000	μmhos
Direct Interelectrode Capacitances (grounded cathode)[2]		
Input	56	pF
Output	18	pF
Feedback	0.13	pF
Frequency of Maximum Rating:		
CW	30	MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the results of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	7.250 in; 184.15 mm
Diameter	5.532 in; 140.51 mm
Net Weight	9 lbs 2½ oz; 4.154 kg
Operating Position	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals	250 °C
Anode Core	250 °C
Cooling	Forced Air
Base	7-Pin Special
Recommended Air System Socket	EIMAC SK-291A
Recommended Air Chimney (included with SK-291A)	EIMAC C-290

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RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN
Class AB_1

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC SUPPRESSOR VOLTAGE	100	VOLTS
DC SCREEN VOLTAGE	1000	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	2.0	AMPERES
PLATE DISSIPATION	5000	WATTS
SCREEN DISSIPATION	50	WATTS
GRID DISSIPATION	2	WATTS

1. Adjust to specified zero-signal dc plate current.
2. The intermodulation distortion products will be as specified or better for all levels from zero-signal to maximum output power and are referenced against one tone of a two equal tone signal.
3. Approximate values.

TYPICAL OPERATION (Frequencies to 30 MHz)
Class AB_1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	5000	5000	6000	Vdc
Suppressor Voltage	0	0	0	Vdc
Screen Voltage	650	750	750	Vdc
Grid Voltage [1]	-93	-109	-111	Vdc
Zero-Signal Plate Current	400	400	400	mAdc
Single Tone Plate Current	1.36	1.69	1.74	Adc
Two-Tone Plate Current	0.91	1.09	1.11	Adc
Zero-Signal Screen Current [3]	6	7	6	mAdc
Single-Tone Screen Current [3/5]	55	80	60	mAdc
Two-Tone Screen Current [3]	23	32	25	mAdc
Peak rf Grid Voltage [3]	90	108	111	v
Useful Output Power [4]	4400	5500	6275	W
Resonant Load Impedance	1950	1550	1600	Ω
Intermodulation Distortion Products [2]				
3rd Order	-29	-26	-25	db
5th Order	-45	-40	-40	db

4. Actual power output delivered to the load from a typical amplifier.
5. Except for brief tuneup periods, operation under single tone conditions may not be possible due to excessive screen dissipation.

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	15.5	18.5	A
Cathode Warmup Time	5	---	minutes
Interelectrode Capacitances [1] (grounded cathode connection)			
Input	51.0	61.0	pF
Output	14.0	22.0	pF
Feedback	---	0.16	pF

1. Capacitance values are for a cold tube as measured in a special shielded fixture.

APPLICATION

MOUNTING - The EIMAC Type 290 may be operated in any position, and should normally be mounted in the air-system socket EIMAC type SK-291A, with a C-290 chimney. The SK-291A has a built-in bypass capacitor for the screen grid, and the suppressor grid contact is grounded.

AIR SYSTEM SOCKET AND CHIMNEY - The SK-291A socket makes all electrical contacts to the Type 290 except to the anode. The suppressor grid contact is grounded to the socket shell. An integral screen grid bypass capacitor is included, with a capacitance of 2000 pF and rated for 1000 Vdc maximum.

The C-290 chimney is designed to mate with the SK-291A socket and guide the cooling air through the anode cooling fins of the tube. The chimney is included with the socket and only when required as a replacement unit would separate procurement be necessary.

COOLING - Forced-air cooling is required in all applications, and the use of an air-system socket, such as the EIMAC SK-291A, with a C-290 chimney, is recommended. Cooling is simplified if air is directed, in a base-to-anode direction; when so directed, with air at 50°C at sea level, minimum air

flow requirements are shown, with approximate pressure drop values for the tube/socket/chimney combination, to limit the maximum anode core temperature to 200°C. If air is not directed in a base-to-anode direction, additional cooling may be required for the base section of the tube. Cooling air should be applied before or simultaneously with the application of electrode voltages, including the heater, and should normally be maintained for a brief period after electrode voltages are removed to allow for tube cooldown.

Anode Diss.	Air Flow	Press. Drop
3000 W	78 cfm	0.32 In. H_2O
4000	124	0.50
5000	166	0.72

HEATER - The rated heater voltage for the Type 290 is 6.0 volts, as measured at the socket or tube base pins. Variations should be restricted to plus or minus 0.3 volt for long tube life and consistent performance.

GRID OPERATION - Grid-bias voltage must be obtained from a fixed bias supply in Class AB applications. The internal resistance of the source should not exceed 2500 ohms.

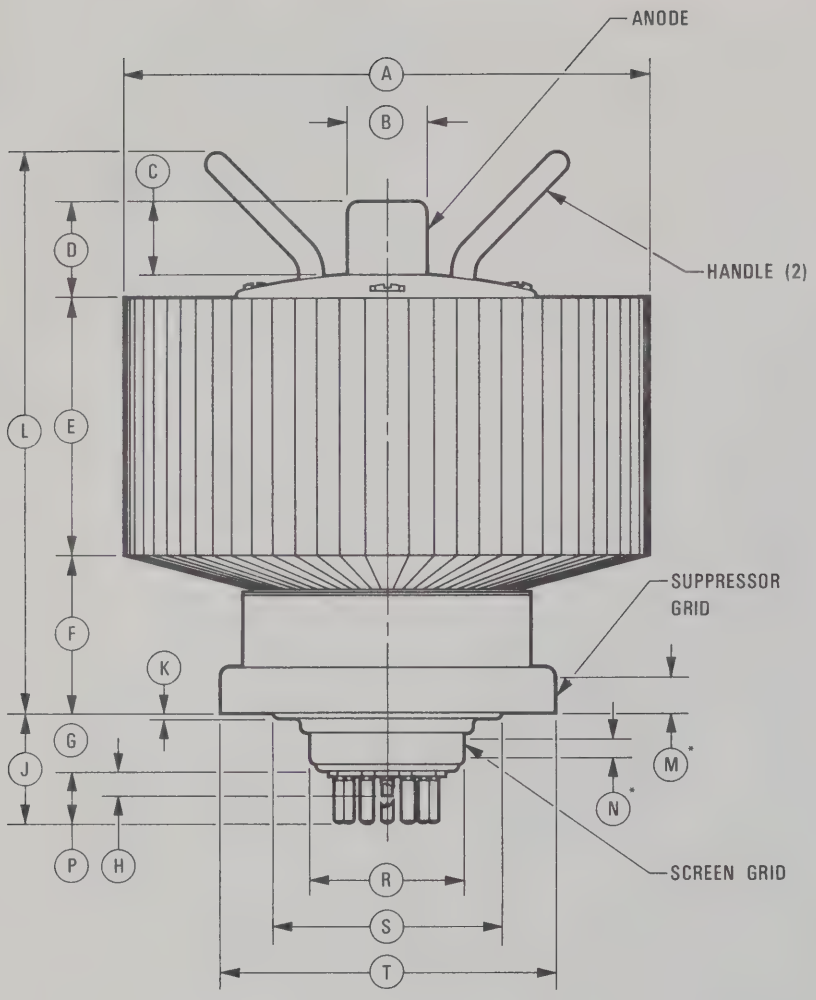
SCREEN OPERATION - In linear amplifier service, the screen voltage must be obtained from a well regulated source, to prevent excessive screen voltage variations due to changes in screen current which occur between zero-signal and full-signal conditions. The circuit should be arranged so that it is impossible to apply screen voltage without plate voltage. The use of a screen grid over-current relay is recommended, to remove screen voltage immediately in case of excessive screen current due to circuit problems, grid bias failure, or accidental removal of plate circuit loading.

PLATE OPERATION - The maximum rated plate dissipation power for the Type 290 is 5000 watts. Except for brief periods during circuit adjustment, this maximum value should not be exceeded. Contact to the plate may be made either at the top cap or by means of a circular clamp or spring-finger collet around the outer surface of the anode cooler itself. Points of electrical contact with the anode should be kept clean and free of oxide to minimize rf loss. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

NEUTRALIZATION FOR RF OPERATION - For minimum-distortion Class AB_1 linear amplifier service, where reaction on the driver circuit should be eliminated completely, it will usually be found advisable to neutralize the small feedback capacitance of the tube.

GENERAL OPERATION NOTES - A metal chassis or equivalent means should be provided to separate the input and output circuits of an rf amplifier employing the Type 290. Reasonable precautions should be observed in regard to bypassing and shielding of supply leads to prevent coupling between input and output through external circuits. The use of the EIMAC SK-291A air-system socket, with its integral screen grid bypass capacitance built in, is helpful in these respects.

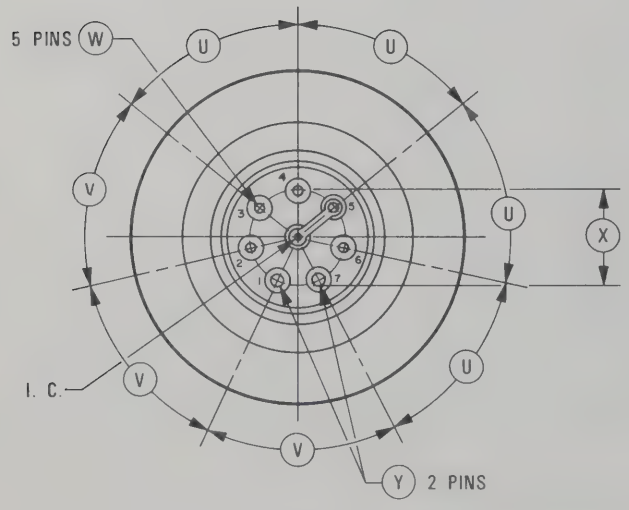
SPECIAL APPLICATION - If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



DIMENSIONAL DATA						
DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	5.468	5.532		138.89	140.51	
B	.805	.819		20.45	20.80	
C	.688	--		17.48	--	
D	.937	1.062		23.80	26.98	
E	2.624	2.688		66.65	68.28	
F	1.625	1.750		41.28	44.45	
G	.624	.688		15.85	17.48	
H	--	--	.187	--	--	4.75
J	1.062	1.250		26.97	31.75	
K	--	.125		--	3.18	
L	--	6.000		--	152.40	
M	.375	--		9.53	--	
N	.220	--		5.59	--	
P	.437	.562		11.10	14.27	
R	1.615	1.629		41.02	41.38	
S	--	2.812		--	46.02	
T	3.484	3.516		88.49	89.31	
U	--	--	51°	--	--	51°
V	--	--	52°	--	--	52°
W	.122	.128		3.10	3.25	
X	--	--	1.000	--	--	25.40
Y	.149	.159		3.78	4.04	

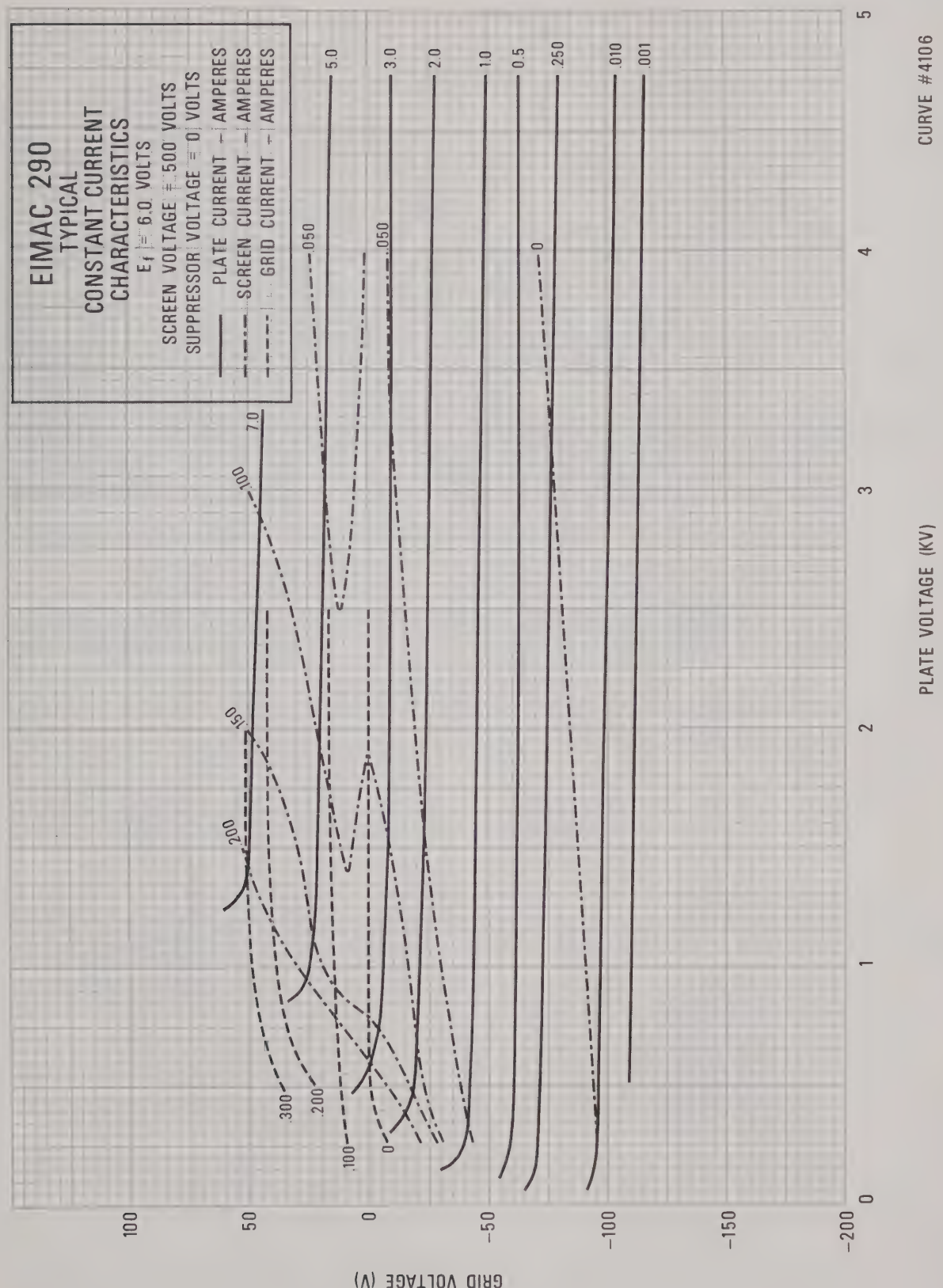
NOTES:

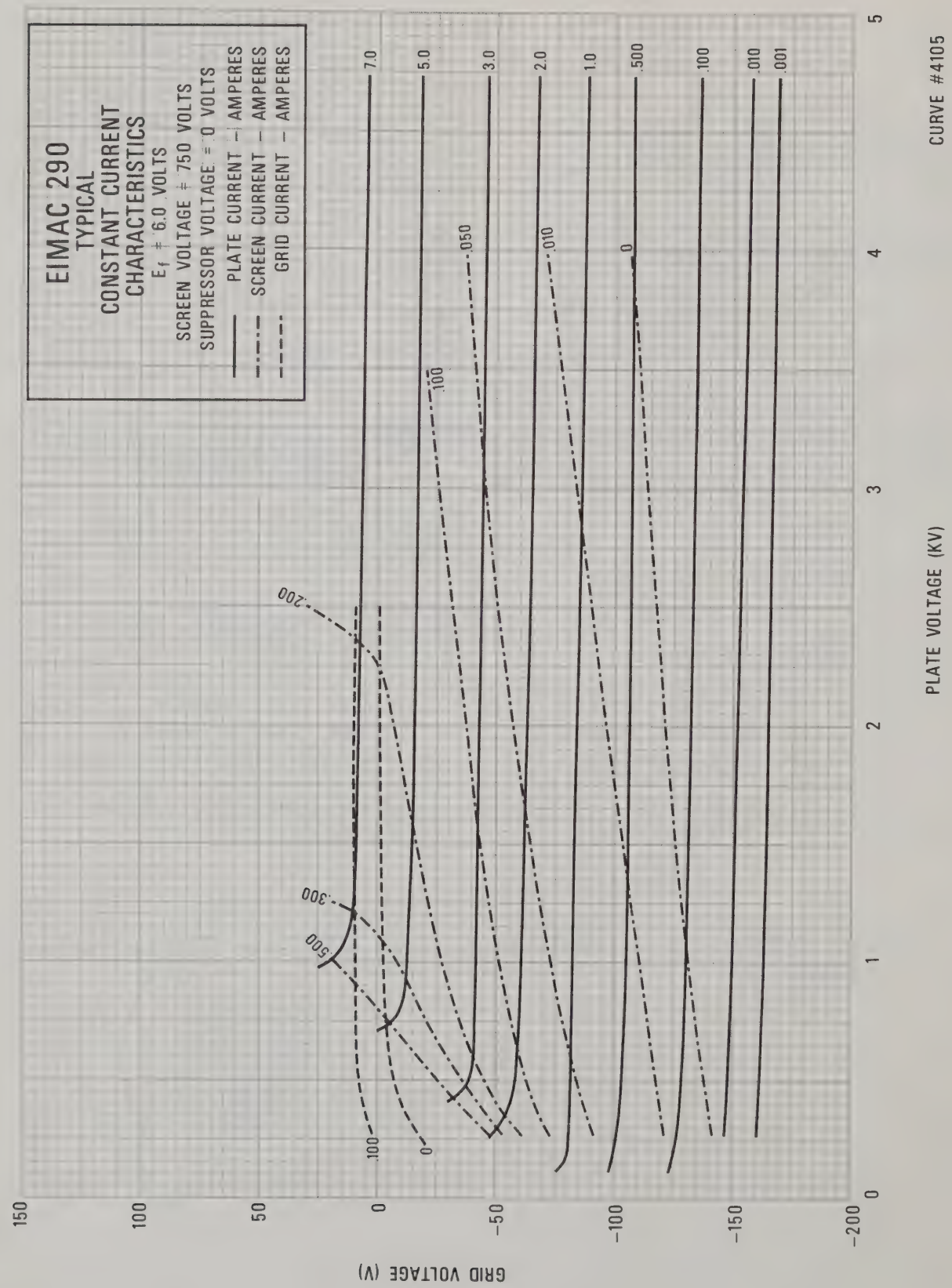
1. (*) CONTACT SURFACE
2. REFERENCE DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.

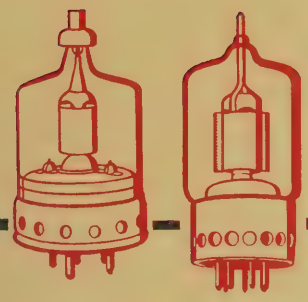


PIN CONNECTIONS

PIN NO.	ELEMENT
1	k
2	g1
3	h
4	k
5	h
6	g1
7	k
CENTER PIN	int. con.
LOWER RING	g2
UPPER RING	g3
CAP	p


EIMAC 290
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.0 VOLTS
SCREEN VOLTAGE = 500 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
7.0
5.0
3.0
2.0
1.0
0.5
.250
.010
.001
.050
0
.050
0
100
150
200
300
200
100
GRID VOLTAGE (V)
100
50
0
-50
-100
-150
-200
0
1
2
3
4
5
PLATE VOLTAGE (KV)
CURVE #4106


EIMAC 290
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
E_f = 6.0 VOLTS
SCREEN VOLTAGE = 750 VOLTS
SUPPRESSOR VOLTAGE = 0 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
7.0
5.0
3.0
2.0
1.0
.500
.100
.010
.001
.100
.050
.010
0
200
300
500
100
0
150
100
50
0
−50
−100
−150
−200
0
1
2
3
4
5
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
CURVE #4105



tetrodes • pentodes

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EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4-65A

RADIAL-BEAM POWER TETRODE

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MODULATOR OSCILLATOR AMPLIFIER



The Eimac 4-65A is a small radiation-cooled transmitting tetrode having a maximum plate-dissipation rating of 65 watts. The plate operates at a red color at maximum dissipation. Short, heavy leads and low interelectrode capacitances contribute to stable efficient operation at high frequencies.

Although it is capable of withstanding high plate voltages, the internal geometry of the 4-65A is such that it will deliver relatively high power ouput at a low plate voltage.

The quick-heating filament allows conservation of power during standby periods in mobile applications.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten		
Voltage	6.0	volts
Current	3.5	amperes
Grid-Screen Amplification Factor (Average)	5	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	0.08	$\mu\mu$f
Input	8.0	$\mu\mu$f
Output	2.1	$\mu\mu$f
Transconductance (Ib = 125 ma., Eb = 500 v., Ec_2 = 250 v.)	4000	μmhos
Frequency for Maximum Ratings	150	Mc.

MECHANICAL

Base	5-pin—Fits { National HX-29 Socket / Johnson 122-101 Socket
Mounting	Vertical, base down or up
Cooling	Convection and Radiation
Recommended Heat Dissipating Connector	Eimac HR-6
Maximum Over-all Dimensions	
Length	4.38 inches
Diameter	2.38 inches
Net Weight	3 ounces
Shipping Weight	1.5 pounds

▶ RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS (Key-down conditions, per tube)

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	150 MAX. MA
PLATE DISSIPATION	65 MAX. WATTS
SCREEN DISSIPATION	10 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	600	1000	1500	2000	3000	volts
D-C Screen Voltage	250	250	250	250	250	volts
D-C Grid Voltage	—75	—80	—85	—90	—100	volts
D-C Plate Current	150	150	150	140	115	ma
D-C Screen Current*	40	40	40	40	22	ma
D-C Grid Current*	18	17	18	11	10	ma
Peak R-F Grid Voltage	170	175	180	190	170	volts
Driving Power*	3.1	3.0	3.2	2.1	1.7	watts
Screen Dissipation*	10	10	10	10	5.5	watts
Plate Power Input	90	150	225	280	345	watts
Plate Dissipation	45	55	60	65	65	watts
Plate Power Output	45	95	165	215	280	watts

*Approximate values.

▶ PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	120 MAX. MA
PLATE DISSIPATION	45 MAX. WATTS
SCREEN DISSIPATION	10 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	600	1000	1500	2000	2500	volts
D-C Screen Voltage	250	250	250	250	250	volts
D-C Grid Voltage	—120	—125	—125	—130	—135	volts
D-C Plate Current	120	120	120	120	110	ma
D-C Screen Current*	40	40	40	40	25	ma
D-C Grid Current*	15	16	16	16	12	ma
Screen Dissipation*	10	10	10	10	6.3	watts
Peak A-F Screen Voltage, 100% Modulation	250	250	250	250	250	volts
Peak R-F Grid Voltage	215	220	220	225	215	volts
Driving Power*	3.2	3.5	3.5	3.6	2.6	watts
Plate Power Input	72	120	180	240	275	watts
Plate Dissipation	27	30	40	45	45	watts
Plate Power Output	45	90	140	195	230	watts

*Approximate values.

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▶ Indicates change from sheet dated 1-30-53

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

▶ AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

MAXIMUM RATINGS (PER TUBE)

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	150 MAX. MA
PLATE DISSIPATION, PER TUBE	65 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	10 MAX. WATTS

TYPICAL OPERATION

Class-AB_1 (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1000	1500	1750	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage[1]	—100	—110	—115	volts
Zero-Signal D-C Plate Current	60	60	40	ma
Max-Signal D-C Plate Current	170	180	170	ma
Max-Signal D-C Screen Current*	30	20	23	ma
Max-Signal D-C Grid Current	0	0	0	
Effective Plate-to-Plate Load	9000	15,000	20,000	ohms
Peak A-F Grid Voltage (per tube)	85	85	90	volts
Max-Signal Plate Power Input	170	270	300	watts
Max-Signal Plate Power Output	80	145	175	watts

*Approximate value.

[1]Adjust to stated zero-signal D-C Plate Current.

The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

TYPICAL OPERATION

Class-AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	600	1000	1500	1800	volts
D-C Screen Voltage	250	250	250	250	volts
D-C Grid Voltage**	—40	—40	—45	—50	volts
Zero-Signal D-C Plate Current	60	60	60	50	ma
Max-Signal D-C Plate Current	300	300	250	220	ma
Max-Signal D-C Screen Current*	80	60	40	30	ma
Effective Plate-to-Plate Load	3600	6800	14,000	20,000	ohms
Peak A-F Grid Voltage (per tube)	120	105	100	90	volts
Max-Signal Peak Driving Power*	7.4	6.0	3.8	2.6	watts
Max-Signal Nominal Driving Power*	3.7	3.0	1.9	1.3	watts
Max-Signal Plate Power Input	180	300	375	395	watts
Max-Signal Plate Power Output	90	170	250	270	watts

*Approximate values.

**Adjust to stated Zero-Signal D-C Plate Current.

▶ RADIO-FREQUENCY LINEAR POWER AMPLIFIER SINGLE SIDE BAND SUPPRESSED CARRIER

Class-B (One tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
PLATE DISSIPATION	65 MAX. WATTS
SCREEN DISSIPATION	10 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

*Adjust to stated Zero-Signal Plate Current.

**Approximate values.

***Due to the intermittent nature of voice, average dissipation is considerably less than Max-Signal Dissipation. If the amplifier is to be tested using a sine-wave signal source, arrangements must be made to lower the duty.

TYPICAL OPERATION

Class-AB_1 (Voice wave only, per tube)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	300	400	500	volts
D-C Grid Voltage*	—55	—80	—105	volts
Zero-Signal D-C Plate Current	35	25	20	ma
Max-Signal D-C Plate Current	200	270	230	ma
Max-Signal D-C Screen Current**	45	65	45	ma
Max-Signal Peak R-F Grid Voltage	150	190	165	volts
Max-Signal D-C Grid Current**	15	20	8	ma
Max-Signal Driving Power**	2.3	3.8	1.3	watts
Max-Signal Plate Power Input	300	540	575	watts
Max-Signal Plate Dissipation***	105	190	225	watts
Average Plate Dissipation	60	65	65	watts
Max-Signal Useful Power Output	150	300	325	watts

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATIONS," POSSIBLY EXCEEDING MAXIMUM RATINGS, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

▶ Indicates change from sheet dated 1-30-53

APPLICATION

MECHANICAL

Mounting—The 4-65A must be mounted vertically, base up or base down. The socket must provide clearance for the glass tip-off which extends from the center of the base. A flexible connecting strap should be provided between the plate terminal and the external plate circuit, and the Eimac HR-6 cooler (or equivalent) used on the tube plate lead. The socket must not apply lateral pressure against the base pins. The tube must be protected from severe vibration and shock.

Adequate ventilation must be provided so that the seals and envelope under operating conditions do not exceed 225°C. For operation above 50 Mc., the plate voltage should be reduced, or special attention should be given to seal cooling.

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten minute period, plate seal temperatures as high as 250°C are permissible. When the ambient temperature does not exceed 30°C it will not ordinarily be necessary to provide forced cooling of the bulb and plate seal to hold the temperature below this maximum at frequencies below 50 Mc, provided that a heat-radiating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

ELECTRICAL

Filament Voltage—The filament voltage, as measured directly at the filament pins, should be between 5.7 volts and 6.3 volts.

Bias Voltage—D-C bias voltage for the 4-65A should not exceed -500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Grid Dissipation—Grid dissipation for the 4-65A should not be allowed to exceed five watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.*

Screen Voltage—The D-C screen voltage for the 4-65A should not exceed 400 volts except in the case of class-AB audio operation and Single Side Band R-F amplifier operation where it should not exceed 600 volts.

Screen Dissipation—The power dissipated by the screen of the 4-65A must not exceed 10 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load is removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 10 watts in the event of circuit failure.

Plate Voltage—The plate-supply voltage for the 4-65A should not exceed 3,000 volts. Above 50 Mc. it is advisable to use a lower plate voltage than the maximum, since the seal heating due to R-F charging currents in the screen leads increases with plate voltage and frequency. See instructions on seal cooling under "Mechanical" and "Shielding."

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-65A should not be allowed to exceed 65 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 45 watts.

Plate dissipation in excess of maximum rating is permissible for short periods of time, such as during tuning procedures.

OPERATION

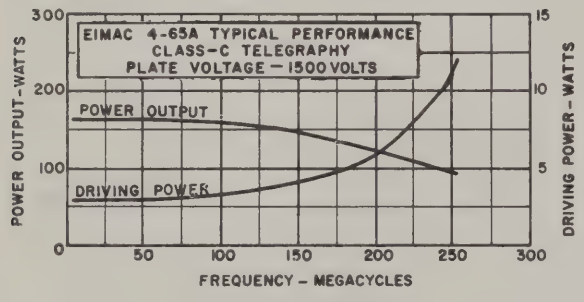
Class-C FM or Telegraphy—The 4-65A may be operated as a class-C FM or telegraph amplifier without neutralization up to 110 Mc. if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. In single ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier, in order to minimize grid-plate coupling between these leads external to the amplifier.

Where shielding is adequate, the feedback at frequencies above 110 Mc. is due principally to screen-lead-inductance effects, and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately ¾" square and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the

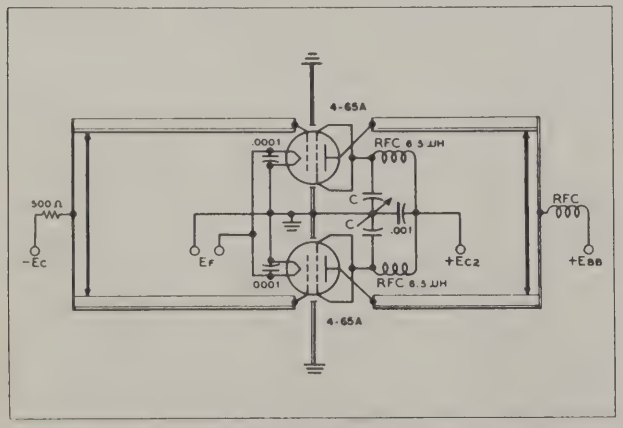
*For suitable peak V.T.V.M. circuits see, for instance, "Vacuum Tube Ratings," **Eimac News,** January 1945. This article is available in reprint form on request.

spacing between the neutralizing capacitor plate and the envelope. An alternate neutralization scheme for use above 110 Mc is illustrated in the diagram on page 4. In this circuit, feedback is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together as shown on the diagram, by the shortest possible lead, and the lead from the mid point of this screen strap to the capacitor, C, and from the capacitor to ground should be made as short as possible.

Driving power and power output under maximum output and plate voltage conditions are shown below. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirements by a sufficient margin to allow for coupling-circuit losses. The use of silver-plated linear tank-circuit elements is recommended for all frequencies above 75 Mc.



Class-C AM Telephony—The R-F circuit considerations discussed above under Class-C FM or Telegraphy also apply to amplitude-modulated operation of the 4-65A. When the 4-65A is used as a class-C high-level-modulated amplifier, both the plate and screen should be modulated. Modulation voltage for the screen is easily obtained by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead, or from a separate winding on the modulation transformer. When screen modulation is obtained by either the series-resistor or the audio-reactor methods, the audio-frequency variations in screen current which result from the variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two to three times the operating D-C screen current. To prevent phase-shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate R-F by-passing.



Screen-tuning neutralization circuit for use above 100 Mc. C is a small split-stator capacitor.

$$C(\mu\mu fd) = \frac{640{,}000}{f^2\ (Mc.)}\text{, approx.}$$

For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

Class-AB_1 and Class-AB_2 Audio—Two 4-65As may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB_1 and class-AB_2 audio operation are given in the tabulated data.

Screen voltage should be obtained from a source having reasonably good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit should provide adequate regulation.

Grid bias voltage for class-AB_2 service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the D-C resistance of the bias source should not exceed 250 ohms. Under class-AB_1 conditions the effective grid-circuit resistance should not exceed 250,000 ohms.

The peak driving power figures given in the class-AB_2 tabulated data are included to make possible an accurate determination of the required driver output power. The driver amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

In some cases the maximum-signal plate dissipation shown under "Typical Operation" is less than the maximum rated plate dissipation of 4-65A. In these cases, with sine wave modulation, the plate dissipation reaches a maximum value, equal to the maximum rating, at a

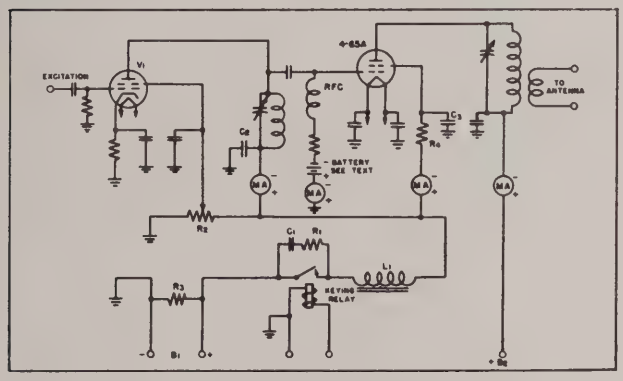
point somewhat below maximum-signal conditions.

The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.

Because of the intermittent nature of the voice, and the low average power, it is possible in cases where size and weight are important to operate a class-AB stage at higher peak power values than those indicated for sine wave.

In order to obtain peak power above that shown for sine wave (peak is twice average for sine wave), the plate-to-plate load impedance must be made proportionately lower than the value shown for a particular plate voltage. Also, more peak driving power will be required. At no time should the average plate or grid dissipation exceed the maximum values shown.

KEYING THE TETRODE AMPLIFIER



Tetrode Keying Circuit

The flow of plate current in an R-F tetrode amplifier depends not only on the control grid bias and excitation, but also on the voltage applied to the screen grid.

One easy method of keying is to remove the excitation and screen grid voltage simultaneously, while leaving the plate voltage still applied to the amplifier stage. This method also has an advantage in that the final tube can be made to draw a safe amount of current key-up position, maintaining a steadier drain on the power supply while keying. This tends to minimize "blinking lights" on weak AC supply lines when using moderate power. By properly choosing the values of L, C, and R, in the circuit, perfectly clean-cut highest speed hand keying can easily be obtained that is entirely devoid of clicks.

The keying circuit is shown in the diagram and V_1 is the driver tube, which may be any one of the small tetrodes such as an 807, 2E26, 6146, 6L6 or 6AG7, used either as a frequency multiplier or a straight-through amplifier. This tube should furnish about five watts of output power which allows ample driving power for one 4-65A, including circuit losses. Capacitance coupling is shown in the diagram, but this, of course, could just as well be link coupling.

Steady driving power is fed to the grid of V_1 from the exciter. The keying circuit controls the plate and screen voltages on V_1, as well as the screen voltage on the 4-65A, all obtained from a common power supply B_1. This supply should furnish sufficient voltage to the plate of V_1 to obtain the necessary driving power. Normally this voltage will be about the correct voltage for the screen of the 4-65A and resistor R_4 may be omitted.

When the key is up there is no excitation to the 4-65A, and consequently no grid leak bias. At the same time, the screen voltage has also been removed so that very little current is drawn by the plate. With plate voltages up to 2000 volts, the amount of current drawn is not sufficient to heat the plate beyond its rated plate dissipation and a fixed bias is not required. However, with plate voltages over 2000 volts, a small fixed bias supply is needed to keep the plate dissipation within the rated limit. An ordinary 22½ volt C battery in the control grid circuit will furnish sufficient bias to completely cut the plate current off at 3000 volts, while some lower value of bias can be used to permit a safe amount of current to flow in key-up position, presenting a more constant load to the power supply.

A tapped resistor R_2 serves to supply screen voltage to V_1 and by adjusting this tap, the excitation to the 4-65A may be easily controlled. This method of controlling the output of a tetrode is not recommended in the larger tetrodes, however, as it is wasteful of power and the lowered power output obtained is due to a loss in efficiency. R_2 also serves as a means of keeping the screen of the 4-65A at ground potential under key-up conditions, stabilizing the circuit. R_3 is the normal power supply bleeder.

The keying relay must be insulated to withstand the driver plate voltage. Key clicks may be completely eliminated by the proper selection of L_1, R_1 and C_1 in series with and across the relay. In many applications values of 500 ohms for R_1 and 0.25 μfd for C_1 have been found entirely satisfactory. Choke L_1 is best selected by trial and usually is on the order of 5 henries. A satisfactory choke for this purpose can be made by using any small power-supply choke, capable of handling the combined current of the final screen grid and the driver stage, and adjusting the air gap to give the proper inductance. This may be checked by listening for clean keying on the "make" side of the signal or by observation in a 'scope.

R-F by-pass condensers C_2 and C_3 will have some effect on the required value of L_1 as well as C_1. These by-pass condensers should be kept at as small a value of capacity as is needed. In most cases .002 μfd is sufficient.

SHIELDING

The internal feedback of the tetrode has been substantially eliminated, and in order to fully utilize this advantage, it is essential that the design of the equipment completely eliminates any feedback external to the tube. This means complete shielding of the output circuit from the input circuit and earlier stages, proper reduction to low values of the inductance of the screen lead to the R-F ground, and elimination of R-F feedback in any common power supply leads.

Complete shielding is easily achieved by mounting the socket of the tube flush with the deck of the chassis as shown in the sketch on page 7.

The holes in the socket permit the flow of convection air currents from below the chassis up past the seals in the base of the tube. This flow of air is essential to cool the tube and in cases where the complete under part of the chassis is enclosed for electrical shielding, screened holes or louvers should be provided to permit air circulation. Note that shielding is completed by aligning the internal screen shield with the chassis deck and by proper R-F by-passing of the screen leads to R-F ground. The plate and output circuits should be kept above deck and the input circuit and circuits of earlier stages should be kept below deck or completely shielded.

DIFFERENT SCREEN VOLTAGES

The published characteristic curves of tetrodes are shown for the commonly used screen voltages. Occasionally it is desirable to operate the tetrode at some screen voltage other than that shown on the characteristic curves. It is a relatively simple matter to convert the published curves to corresponding curves at a different screen voltage by the method to be described.

This conversion method is based on the fact that if all inter-electode voltages are either raised or lowered by the same relative amount, the shape of the voltage field pattern is not altered, nor will the current distribution be altered; the current lines will simply take on new proportionate values in accordance with the three-halves power law. This method fails only where insufficient cathode emission or high secondary emission affect the current values.

For instance, if the characteristic curves are shown at a screen voltage of 250 volts and it is desired to determine conditions at 500 screen volts, all voltage scales should be multiplied by the same factor that is applied to the screen voltage (in this case—2). The 1000 volt plate voltage point now becomes 2000 volts, the 50 volt grid voltage point, 100 volts, etc.

The current lines then all assume new values in accordance with the 3/2 power law. Since the voltage was increased by a factor of 2, the current lines will all be increased in value by a factor of $2^{3/2}$ or 2.8. Then all the current values should be multiplied by the factor 2.8. The 100 ma. line becomes a 280 ma. line, etc.

Likewise, if the screen voltage given on the characteristic curve is higher than the conditions desired, the voltages should all be reduced by the same factor that is used to obtain the desired screen voltage. Correspondingly, the current values will all be reduced by an amount equal to the 3/2 power of this factor.

For convenience the 3/2 power of commonly used factors is given below:

Voltage Factor	.25	.5	.75	1.0	1.25	1.50	1.75
Corresponding Current Factor	.125	.35	.65	1.0	1.4	1.84	2.3

Voltage Factor	2.0	2.25	2.5	2.75	3.0
Corresponding Current Factor	2.8	3.4	4.0	4.6	5.2

SINGLE SIDE BAND SUPPRESSED CARRIER OPERATION

The 4-65A may be operated as a class B linear amplifier in SSSC operation and peak power outputs of over 300 watts per tube may be readily obtained. This is made possible by the intermittent nature of the voice. If steady audio sine wave modulation is used, the single side band will be continuous and the stage will operate as a C-W class-B amplifier. With voice modulation the average power will run on the order of 1/5th of this continuous power.

The same precautions regarding shielding, coupling between input and output circuits, and proper R-F bypassing must be observed, as described under Class-C Telegraphy Operation.

Due to the widely varying nature of the load imposed on the power supplies by SSSC operation, it is essential that particular attention be given to obtaining good regulation in these supplies. The bias supply especially, should have excellent regulation, and the addition of a heavy bleeder to keep the supply well loaded will be found helpful.

Under conditions of zero speech signal, the operating bias is adjusted so as to give a plate dissipation of 50 watts at the desired plate and screen voltages. Due to the intermittent nature of voice, the average plate dissipation will rise only slightly under full speech modulation to approximately 65 watts. At the same time, however, the peak speech power output of over 300 watts is obtained.

SSSC TUNING PROCEDURE

Tuning the SSSC transmitter is best accomplished with the aid of an audio frequency oscillator and a cathode-ray oscilloscope. The audio oscillator should be capable of delivering a sine wave output of a frequency of around 800 to 1000 cycles so that the frequency will be somewhere near the middle of the pass-band of the audio system. Since successful operation of the class-B stage depends on good linearity and the capability of delivering full power at highest audio levels, the final tuning should be made under conditions simulating peak modulation conditions. If a continuous sine wave from the audio oscillator is used for tuning purposes, the average power at full modulation would be about five times that of speech under similar conditions of single side band operation and the final amplifier would be subjected to a heavy overload. One method of lowering the duty cycle of the audio oscillator to closer approxi-

mate speech conditions would be to modulate the oscillator with a low frequency.

An alternate method would be to use the continuous audio sine wave, making all adjustments at half voltages and half currents on the screen and plate, thus reducing the power to one quarter. The stand-by plate dissipation under these conditions should be set at about 10 watts. Following these adjustments, minor adjustments at full voltages and 50 watts of stand-by plate dissipation could then be made, but only allowing the full power to remain on for ten or fifteen second intervals.

The first step is to loosely couple the oscilloscope to the output of the exciter unit. The final amplifier with its filament and bias voltages turned on should also be coupled to the exciter at this time. With the audio oscillator running, adjust the exciter unit so that it delivers double side band signals. Using a linear sweep on the oscilloscope, the double side band pattern will appear on the screen the same as that obtained from a 100% sine wave modulated AM signal. Next vary the audio gain control so that the exciter can be checked for linearity. When the peaks of the envelope start to flatten out the upper limit of the exciter output has been reached and the maximum gain setting should be noted. The coupling to the final stage should be varied during this process and a point of optimum coupling determined by watching the oscilloscope pattern and the grid meter in the final stage.

Next, adjust the exciter for single side band operation and if it is working properly, the pattern on the oscilloscope will resemble an unmodulated AM carrier. The phasing controls should be adjusted so as to make the envelope as smooth on the top and bottom as possible. If the above conditions are satisfied, the exciter unit can be assumed to be operating satisfactorily.

Next, loosely couple the oscilloscope link to the output of the final amplifier and again adjust the exciter unit to give double side band output.

If the reduced duty cycle method is used, the following tuning procedure may be followed:

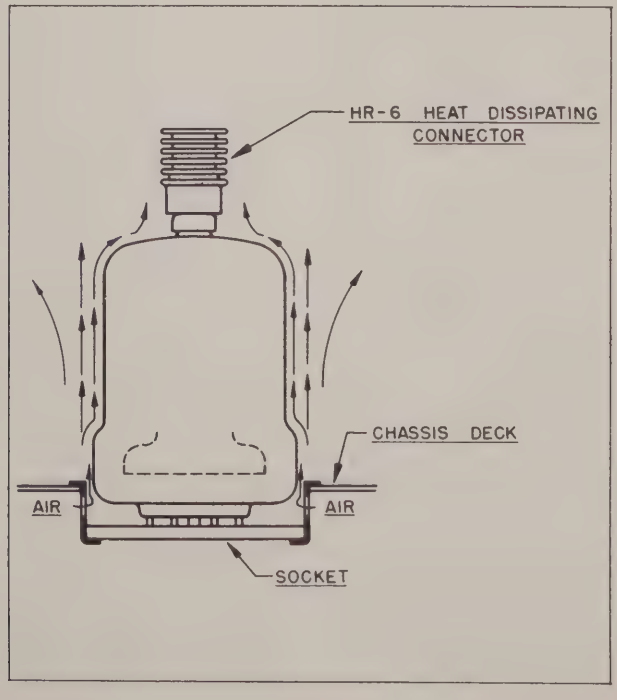
1. Cut the audio output to zero.
2. Apply 120 volts of bias to the 4-65A control grid.
3. Apply the operating plate voltage followed by the operating screen voltage.
4. Reduce bias voltage to obtain 50 watts of stand-by plate dissipation.
5. Increase audio gain, checking the oscilloscope pattern for linearity as in the case of the exciter, and adjust for optimum antenna coupling.
6. Re-adjust exciter unit for single side band operation.
7. Disconnect test signal and connect microphone.
8. Adjust the audio gain so that the voice peaks give the same deflection on the oscilloscope screen as was obtained from the test signal peaks.

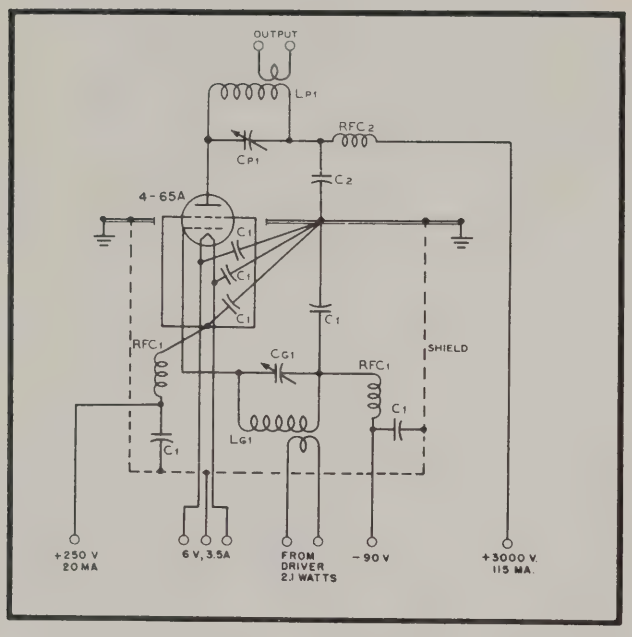
If the alternate method is used with a 100% duty cycle from the audio oscillator, then step 3 should be to apply half voltages and the stand-by plate dissipation should be set at 10 watts.

After the audio oscillator is disconnected and step 8 completed at half voltages, the full voltages can then be applied and the stand-by plate dissipation adjusted for 50 watts.

It is essential that the microphone cable be well shielded and grounded to avoid R-F feedback that might not occur when the lower impedance audio oscillator is used as an audio source.

Typical operational data are given for SSSC in the first part of this data sheet.

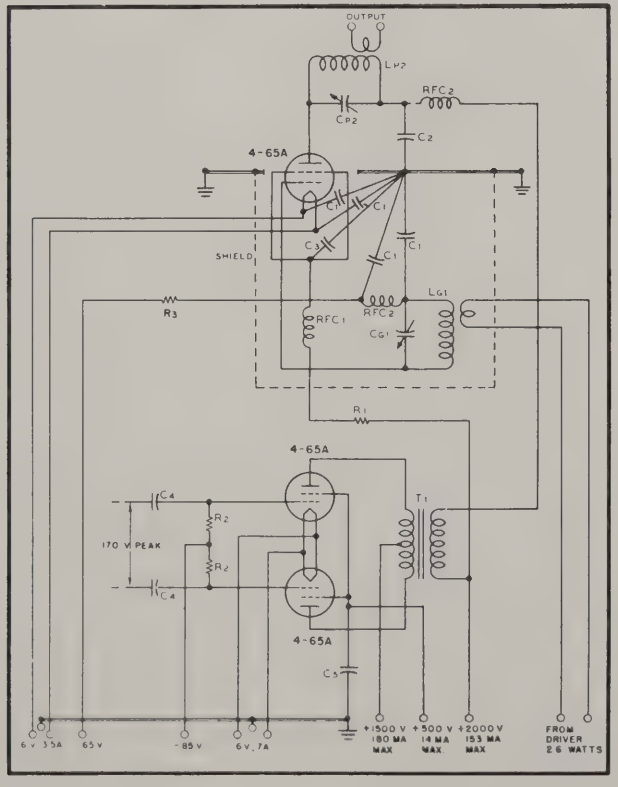




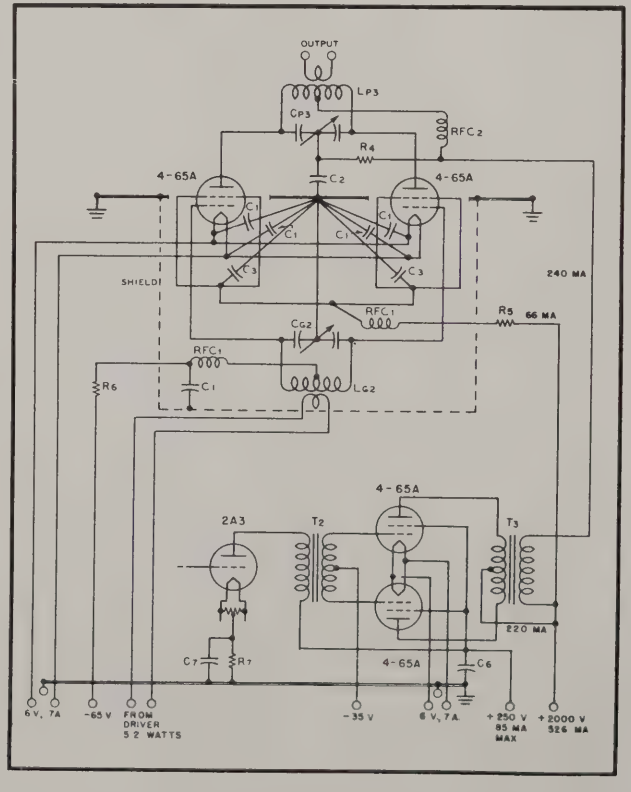
Typical radio-frequency power amplifier circuit, Class-C telegraphy, 345 watts input.

COMPONENTS FOR TYPICAL CIRCUITS

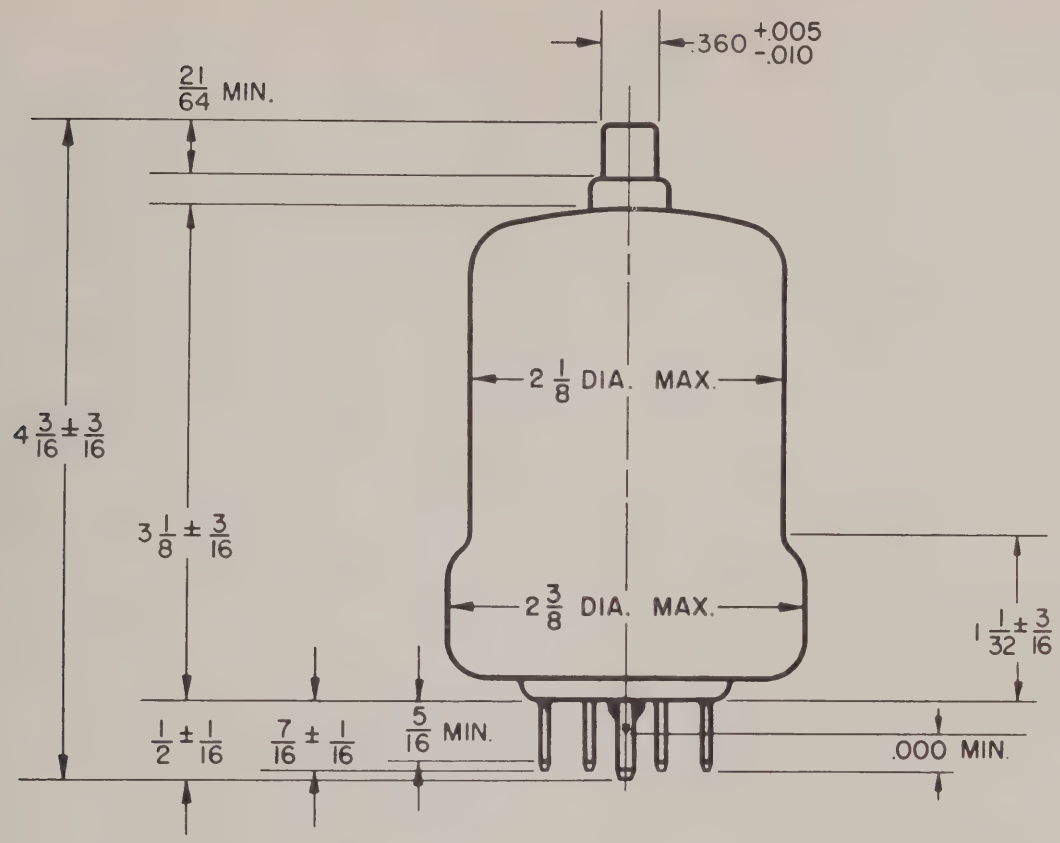
L_{p1}-C_{p1}— Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".
L_{p2}-C_{p2}— Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".
L_{p3}-C_{p3}— Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".
L_{g1}-C_{g1}— Tuned circuit appropriate for operating frequency.
L_{g2}-C_{g2}— Tuned circuit appropriate for operating frequency.
C_1— .002 -μfd. 500V Mica
C_2— .002 -μfd. 5000V Mica
C_3— .001 -μfd. 2500V Mica
C_4— .1 -μfd. 1000V paper
C_5— .1 -μfd. 600 V paper
C_6— 16 -μfd. 450V Electrolytic
C_7— 10 -μfd. 100V Electrolytic
R_1—53,000 ohms 200 watt—60,000 ohm adjustable
R_2—250,000 ohms 1 watt
R_3— 5,000 ohms 5 watt
R_4— 25,000 ohms 2 watts
R_5— 26,500 ohms 200 watts—30,000 ohm adjustable
R_6— 2,500 ohms 5 watts
R_7— 750 ohms 5 watts
RFC_1— 2.5 mhy. 125 ma. R-F choke
RFC_2— 1 mhy. 500 ma. R-F choke
T_1— 150 watt modulation transformer; ratio primary to secondary impedance approx. 1:1.1 Pri. impedance 15,000 ohms, sec. impedance 16,700 ohms.
T_2— 5 watt driver transformer impedance ratio primary to 1/2 secondary 1.5:1.
T_3— 300 watt modulation transformer; impedance ratio pri. to sec. approx. 2.4:1; Pri. impedance = 20,000 ohms, sec. impedance = 8,333 ohms.

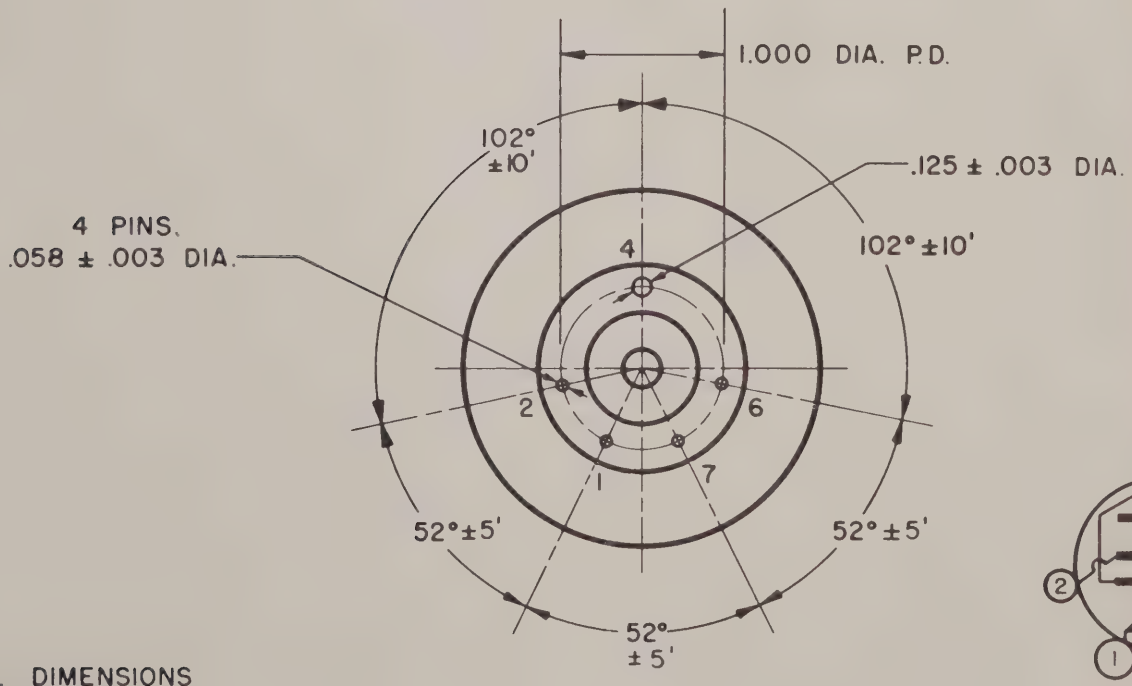


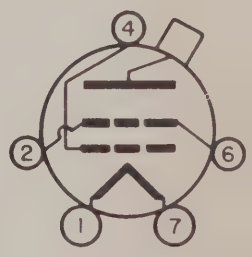
Typical high-level-modulated R-F amplifier, 240 watts plate input. Modulator requires zero driving power.



Typical high-level-modulated R-F amplifier circuit, with modulator and driver stages, 480 watts plate input.

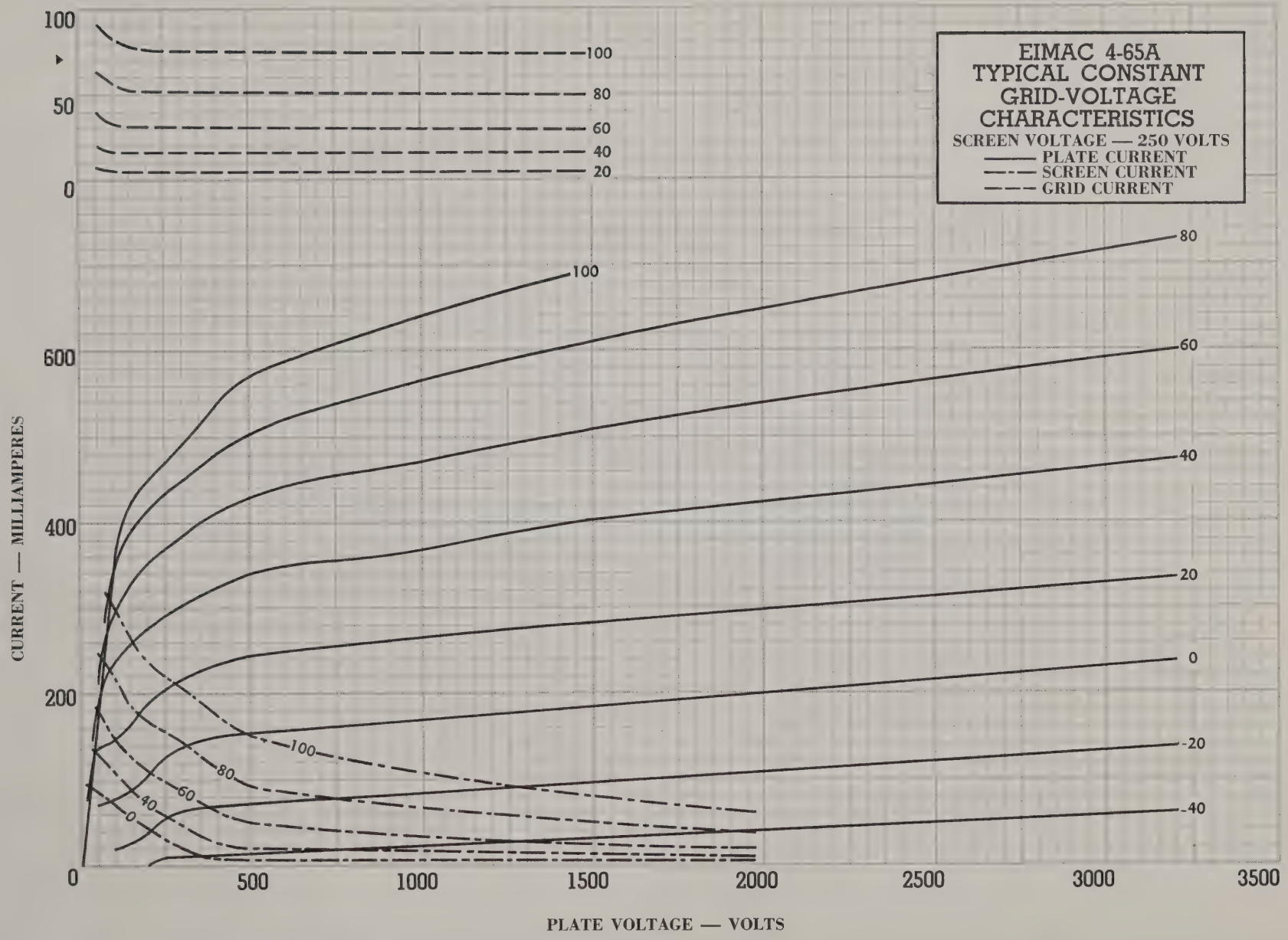






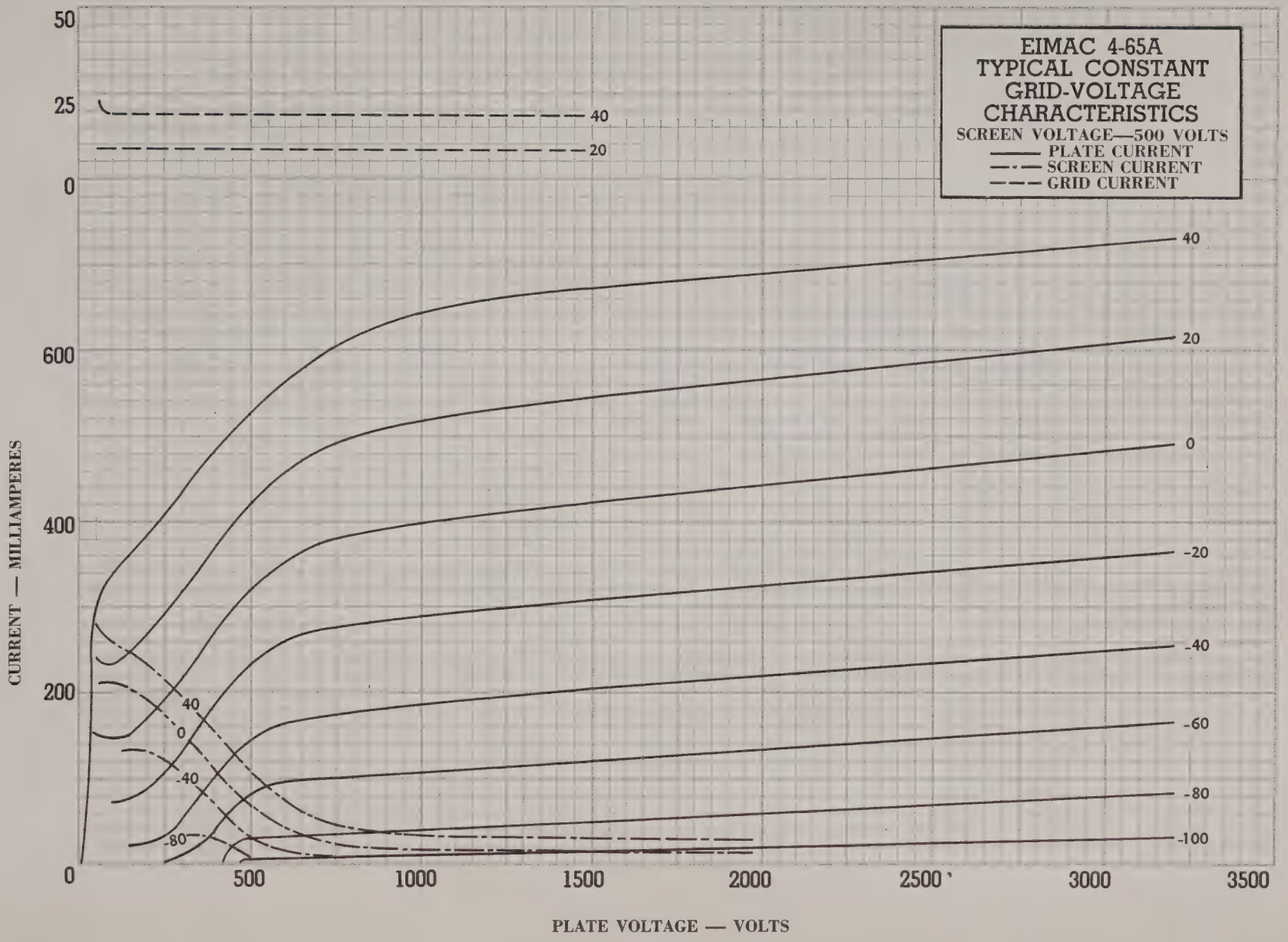
ALL DIMENSIONS IN INCHES

BOTTOM VIEW

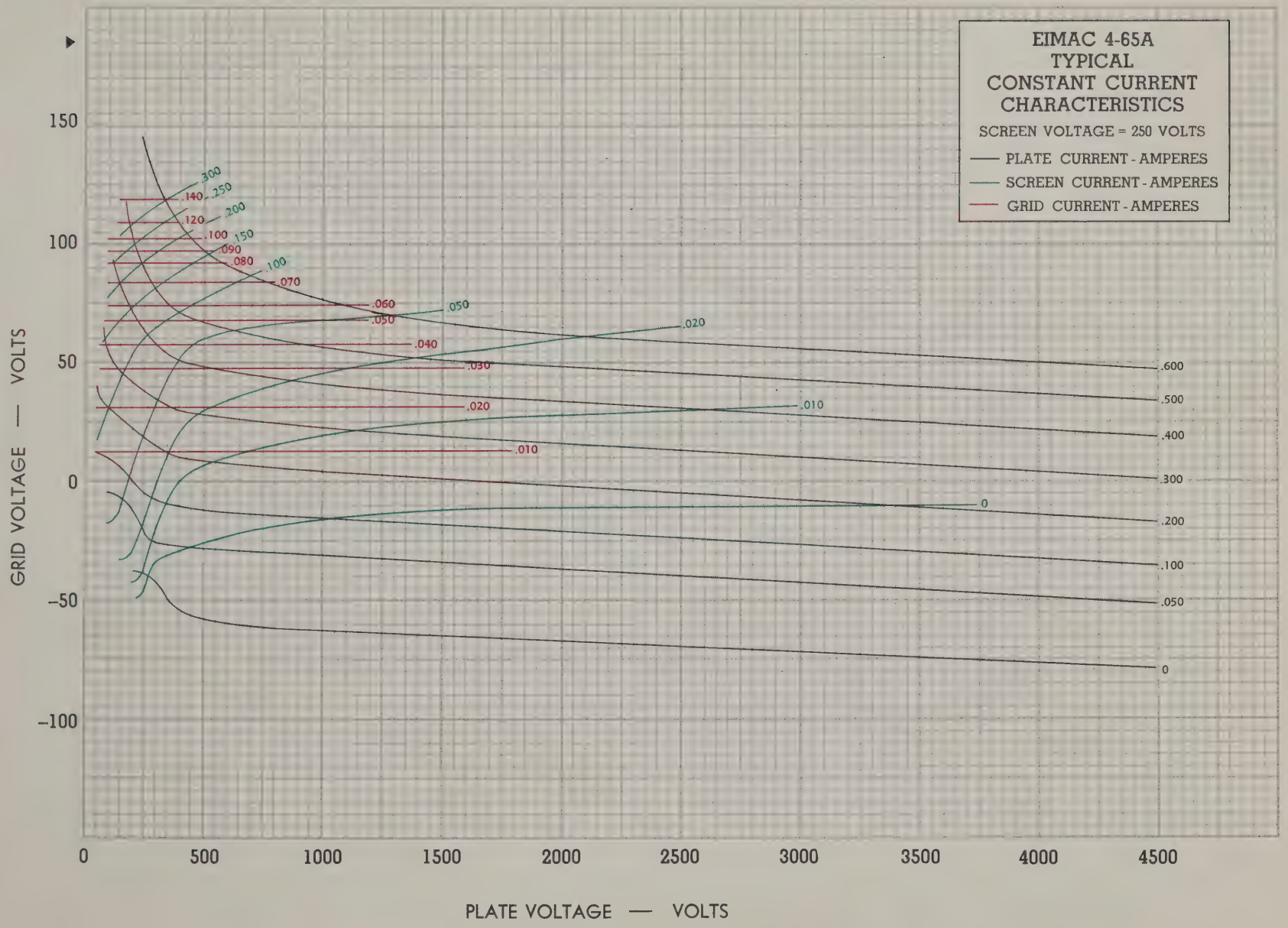


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Eimac 4-65A


EIMAC 4-65A
TYPICAL CONSTANT
GRID-VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE—500 VOLTS
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
CURRENT — MILLIAMPERES
PLATE VOLTAGE — VOLTS
50
25
0
600
400
200
0
500
1000
1500
2000
2500
3000
3500
40
20
0
-20
-40
-60
-80
-100

Eimac 4-65A



Eimac 4-65A

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Printed in USA 5-17—80380

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4-125A

(4D21)

RADIAL-BEAM POWER TETRODE

•

MODULATOR
OSCILLATOR
AMPLIFIER



The Eimac 4-125A is a radial-beam power tetrode intended for use as an amplifier, oscillator, or modulator. It has a maximum plate-dissipation rating of 125 watts and a maximum plate-voltage rating of 3000 volts at frequencies up to 120 Mc.

The low grid-plate capacitance of this tetrode together with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

Cooling is by radiation from the plate and by air circulation through the base and around the envelope.

The 4-125A in class-C r-f service will deliver up to 375 watts plate power output with 2.5 watts driving power. Two 4-125A's in class-B modulator service will deliver up to 400 watts maximum-signal power output with 1.2 watts nominal driving power.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	6.5 amperes
Grid-Screen Amplification Factor (Average)	5.9
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.05 μμfd
Input	10.8 μμfd
Output	3.1 μμfd
Transconductance (I_b=50 ma., E_b=2500V., E_{c2}=400V.)	2450 μmhos
Highest Frequency for Maximum Ratings	120 Mc

MECHANICAL

Base	5-pin metal shell
Basing	See outline drawing
Socket	E. F. Johnson Co. socket No. 122-275, National Co. No. HX-100, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Plate Connector	Eimac HR-6
▶ Maximum Over-all Dimensions:	
Length	5.69 inches
Diameter	2.81 inches
Net Weight	6.5 ounces
Shipping Weight	1.5 pounds

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

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RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	225 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 120 Mc.)

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage	—100	—150	—150	volts
D-C Plate Current	200	200	167	ma
D-C Screen Current	50	40	30	ma
D-C Grid Current	12	12	9	ma
Screen Dissipation	18	14	10.5	watts
Grid Dissipation	1.6	2	1.2	watts
Peak R-F Grid Input Voltage (approx.)	230	320	280	volts
Driving Power (approx.)[3]	2.8	3.8	2.5	watts
Plate Power Input	400	500	500	watts
Plate Dissipation	125	125	125	watts
Plate Power Output	275	375	375	watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	600	600	600	volts
D-C Grid Voltage[2]	—90	—94	—96	volts
Zero-Signal D-C Plate Current	60	50	50	ma
Max-Signal D-C Plate Current	222	240	232	ma
Zero-Signal D-C Screen Current	—1.0	—0.5	—0.3	ma
Max-Signal D-C Screen Current	17	6.4	8.5	ma
Effective Load, Plate-to-Plate	10,200	13,400	20,300	ohms
Peak, A-F Grid Input Voltage (per tube)	90	94	96	volts
Driving Power	0	0	0	watt
Max-Signal Plate Dissipation (per tube)	87.5	125	125	watts
Max-Signal Plate Power Output	158	230	330	watts
Total Harmonic Distortion	5	2	2.6	per ct.

HIGH-LEVEL MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony
(Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	85 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 120 Mc.)

D-C Plate Voltage	2000	2500	volts
D-C Screen Voltage	350	350	volts
D-C Grid Voltage	—220	—210	volts
D-C Plate Current	150	152	ma
D-C Screen Current	33	30	ma
D-C Grid Current	10	9	ma
Screen Dissipation	11.5	10.5	watts
Grid Dissipation	1.6	1.4	watts
Peak A-F Screen Voltage, 100% Modulation	210	210	volts
Peak R-F Grid Input Voltage (approx.)	375	360	volts
Driving Power (approx.)[3]	3.8	3.3	watts
Plate Power Input	300	380	watts
Plate Dissipation	75	80	watts
Plate Power Output	225	300	watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_2

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage	—41	—45	—43	volts
Zero-Signal D-C Plate Current	87	72	93	ma
Max-Signal D-C Plate Current	400	300	260	ma
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	34	5	6	ma
Effective Load, Plate-to-Plate	7200	13,600	22,200	ohms
Peak A-F Grid Input Voltage (per tube)	141	105	89	volts
Max-Signal Avg. Driving Power (approx.)	2.5	1.4	1	watts
Max-Signal Peak Driving Power	5.2	3.1	2.4	watts
Max-Signal Plate Dissipation (per tube)	125	125	122	watts
Max-Signal Plate Power Output	350	350	400	watts
Total Harmonic Distortion	2.5	1	2.2	per ct.

[1] Above 120 Mc. the maximum plate voltage rating depends upon frequency. See page 4.

[2] The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

[3] Driving power increases above 70 Mc. See page 4.

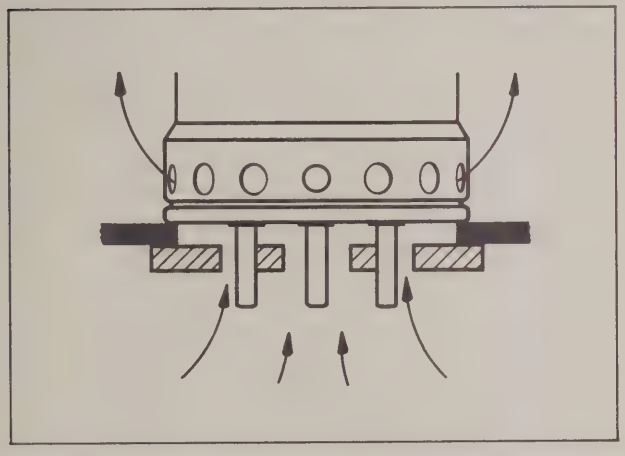
IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting—The 4-125A must be mounted vertically, base down or base up. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The tube should be mounted above the chassis deck to allow free circulation of air in the manner shown in the mounting diagram below. The above requirements are met by the E. F. Johnson Co. socket No. 122-275, the National Co. socket No. HX-100, or a similar socket.

A flexible connecting strap should be provided between the HR-6 Heat Dissipating Plate Connector on the plate terminal and the external circuit. The tube must be protected from severe vibration and shock.



4-125A mounting providing base cooling, shielding and isolation of output and input compartments.

Cooling—Adequate cooling must be provided for the seals and envelope of the 4-125A. In continuous-service applications, the temperature of the plate seal, as measured on the top of the plate cap, should not exceed 170° C. A relatively slow movement of air past the tube is sufficient to prevent seal temperatures in excess of maximum at frequencies below 30 Mc. At frequencies above 30 Mc., radio frequency losses in the leads and envelope contribute to seal and envelope heating, and special attention should be given to cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 Mc., however.

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten-minute period, plate seal temperatures as high as 220° C. are permissible. When the ambient temperature does not exceed 30° C. it will not ordinarily be necessary to provide forced cooling to hold the temperature below this maximum at frequencies below 30 Mc., provided that a heat-dissipating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

Provision must be made for circulation of air through the base of the tube. Where shielding or socket design makes it impossible to allow free circulation of air through the base, it will be necessary to apply forced-air cooling to the stem structure. An air flow of two cubic feet per minute through the base will be sufficient for stem cooling.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage—D-c bias voltage for the 4-125A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Screen Voltage—The d-c screen voltage for the 4-125A should not exceed 400 volts, except for class-AB_1 audio operation.

Plate Voltage—The plate-supply voltage for the 4-125A should not exceed 3000 volts for frequencies below 120 Mc. The maximum permissible plate voltage is less than 3000 volts above 120 Mc., as shown by the graph on page 5.

Grid Dissipation—Grid dissipation for the 4-125A should not be allowed to exceed five watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid[4].

Screen Dissipation—The power dissipated by the screen of the 4-125A must not exceed 20 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 20 watts in the event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-125A should not be allowed to exceed 125 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 85 watts. The plate dissipation will rise to 125 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

[4] For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings", **Eimac News**, January, 1945. This article is available in reprint form on request.

OPERATION

Class-C Telegraphy or FM Telephony—The 4-125A may be operated as a class-C telegraph or FM telephone amplifier without neutralization up to about 30 Mc. if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. A grounded metallic plate on which the socket may be mounted as shown in the mounting diagram on page three provides an effective isolating shield between grid and plate circuits. In single-ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier, to prevent grid-plate coupling between these leads external to the amplifier.

Where shielding is adequate, the feed-back at frequencies above 100 Mc. is due principally to screen-lead-inductance effects, and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately ¾-inch square connected to the grid terminal and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope, but care must be taken to prevent the neutralizing plate from touching the envelope. An alternative neutralization scheme is illustrated in the diagram below. In this circuit feed-back is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together, as shown on the diagram, by the shortest posible lead, and the leads from the screen terminal to the capacitor, C, and from the capacitor to ground should be made as short as possible. All connections to the screen terminals should be made to the center of the strap between the terminals, in order to equalize the current in the two screen leads and prevent overheating one of them. The value for C given under the diagram presupposes the use of the shortest possible leads.

At frequencies below 100 Mc. ordinary neutralization systems may be used. With reasonably effective shielding, however, neutralization should not be required below about 30 Mc.

The driving power and power output under typical operating conditions, with maximum output and plate voltage, are shown on page 5. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirement by a sufficient margin to allow for coupling-circuit losses. These losses will not ordinarily amount to more than 30 or 40 per cent of the driving power, except at frequencies above 150 Mc. The use of silver-plated linear tank-circuit elements is recommended at frequencies above 100 Mc.

Conventional capacitance - shortened quarter - wave linear grid tank circuits having a calculated Z_0 of 160 ohms or less may be used with the 4-125A up to 175 Mc. Above 175 Mc. linear grid tank circuits employing a "capacitor"-type shortening bar, as illustrated in the diagram below, may be used. The capacitor, C_1, may consist of two silver-plated brass plates one inch square with a piece of .010 inch mica or polystyrene as insulation.

Class-C AM Telephony—The r-f circuit considerations discussed above under Class-C Telegraphy or FM Telephony also apply to amplitude-modulated operation of the 4-125A. When the 4-125A is used as a class-C high-level-modulated amplifier, modulation should be applied to both plate and screen. Modulation voltage for the screen may be obtained from a separate winding on the modulation transformer, by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead. When screen modulation is obtained by either the series-resistor or the audio-reactor method, the audio-frequency variations in screen current which result from variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two or three times the operating d-c screen current. To prevent phase shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate r-f by-passing. Where screen voltage is obtained from a separate winding on the modulation transformer, the screen winding should be designed to deliver the peak screen modulation voltage given in the typical operating data on page 2.

For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

Class-AB_1 and Class-AB_2 Audio—Two 4-125A's may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB_1 and class-AB_2 audio operation are given in the tabulated data.

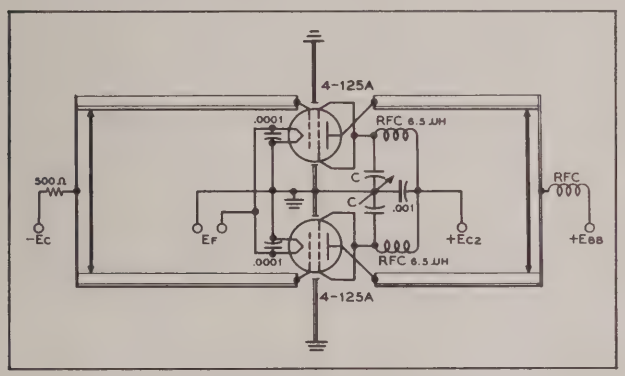
When type 4-125A tubes are used as class-AB_1 or class-AB_2 audio amplifiers at 1500 plate volts, under the conditions given under "Typical Operation", the screen voltage must be obtained from a source having reasonably good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit will provide adequate regulation. The variation in screen current at plate voltages of 2000 and above is low enough so that any screen power supply having a normal order

of regulation will serve. The driver plate supply makes a convenient source of screen voltage under these conditions.

Grid bias voltage for class-AB_2 service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB_1 conditions the effective grid-circuit resistance for each tube should not exceed 250,000 ohms.

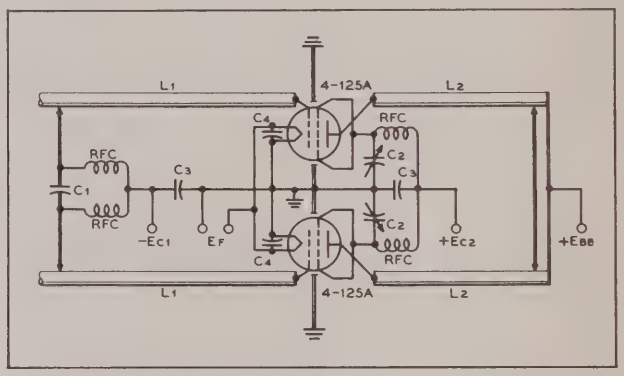
The peak driving power figures given in the class-AB_2 tabulated data are included to make possible an accurate determination of the required driver output power. The driving amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.



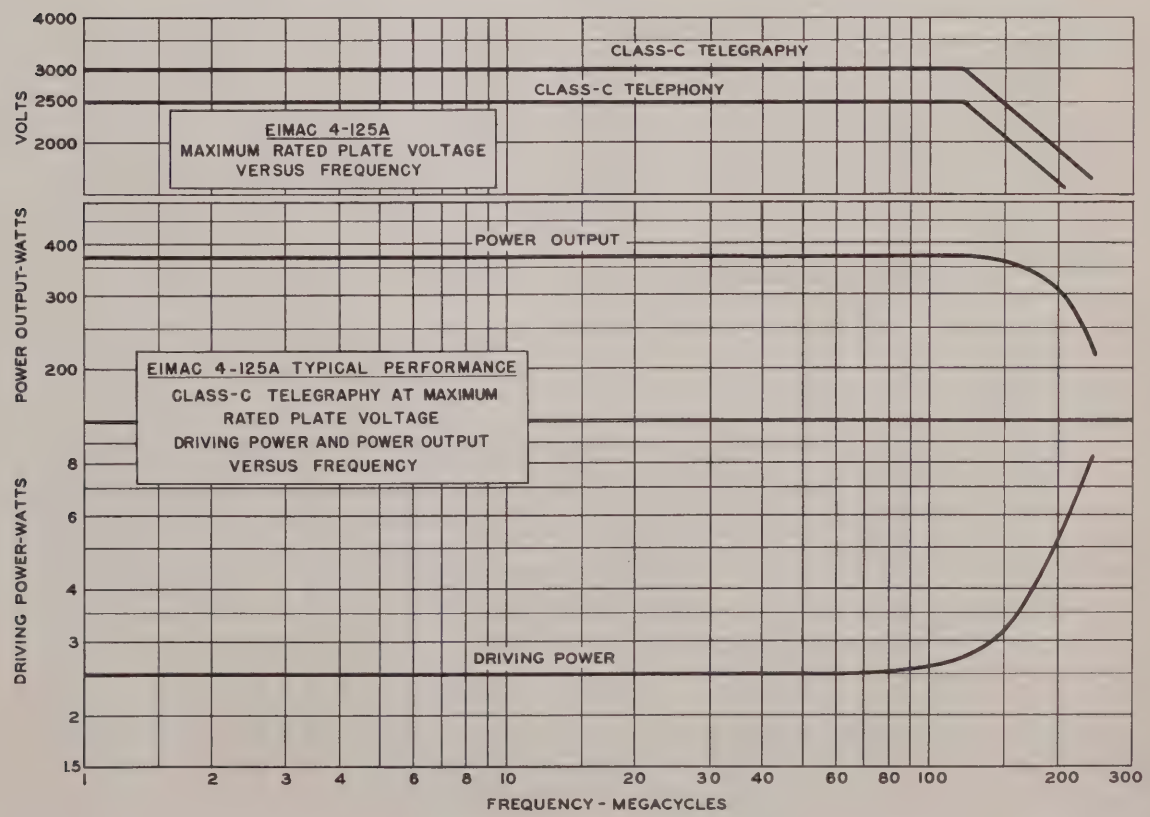
Screen-tuning neutralization circuit for use above 100 Mc. C is a small split-stator capacitor.

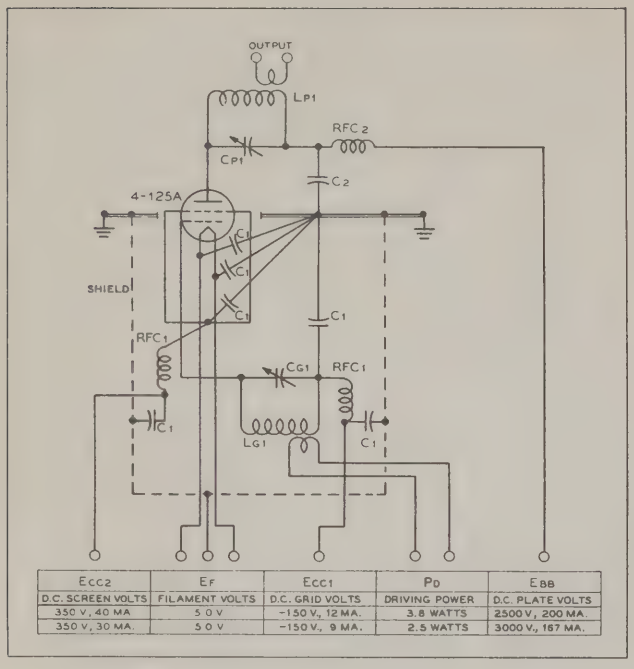
$$C(\mu\mu fd) = \frac{640{,}000}{f^2\ (Mc.)}\ ,\ approx.$$



Typical circuit arrangement useful for frequencies above 175 Mc.

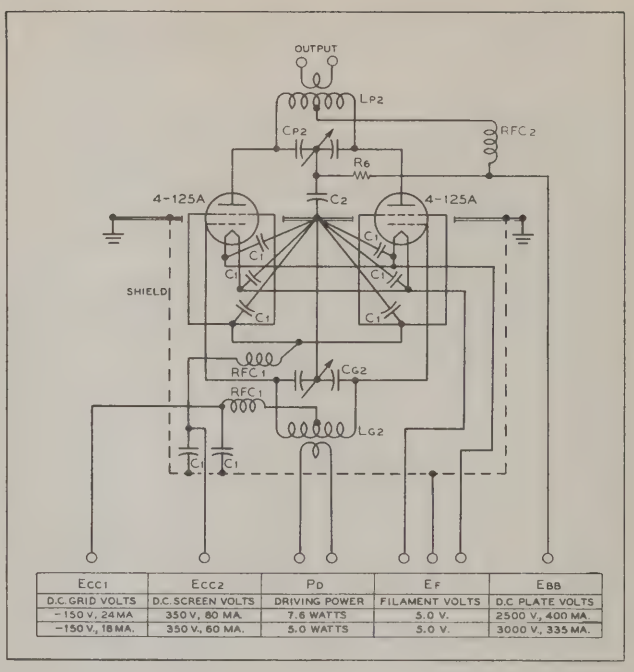
C_1—See above.
C_2—Neutralizing capacitor.
C_3—.001 μfd.
C_4—100 $\mu\mu$fd.
L_1—3/8" dia. copper spaced 1" center-to-center, 6" long.
L_2—7/8" dia. brass, silver plated, spaced 1 1/2" center-to-center, 14" long.





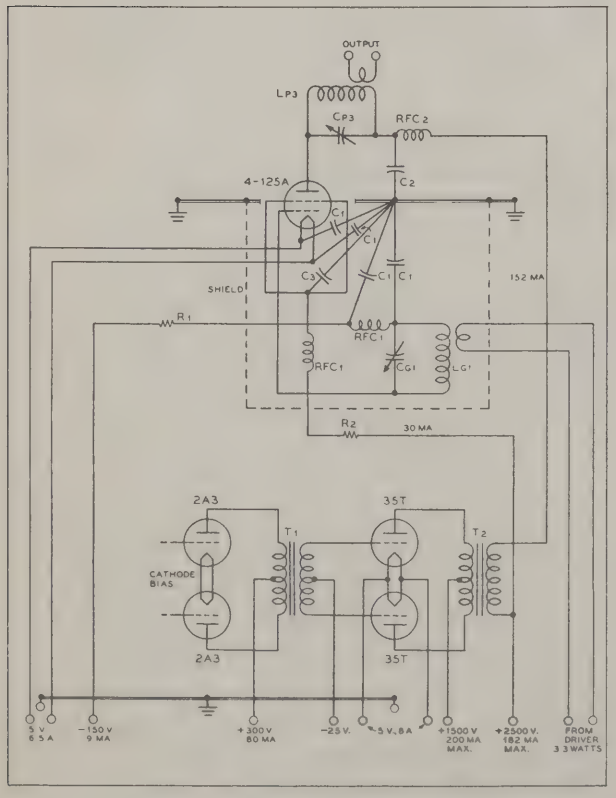
Ecc2	Ef	Ecc1	Pd	Ebb
D.C. SCREEN VOLTS	FILAMENT VOLTS	D.C. GRID VOLTS	DRIVING POWER	D.C. PLATE VOLTS
350 V, 40 MA.	5.0 V	−150 V, 12 MA.	3.8 WATTS	2500 V., 200 MA.
350 V, 30 MA.	5.0 V	−150 V., 9 MA.	2.5 WATTS	3000 V., 167 MA.

Typical radio-frequency power amplifier circuit, Class-C telegraphy, 500 watts input.

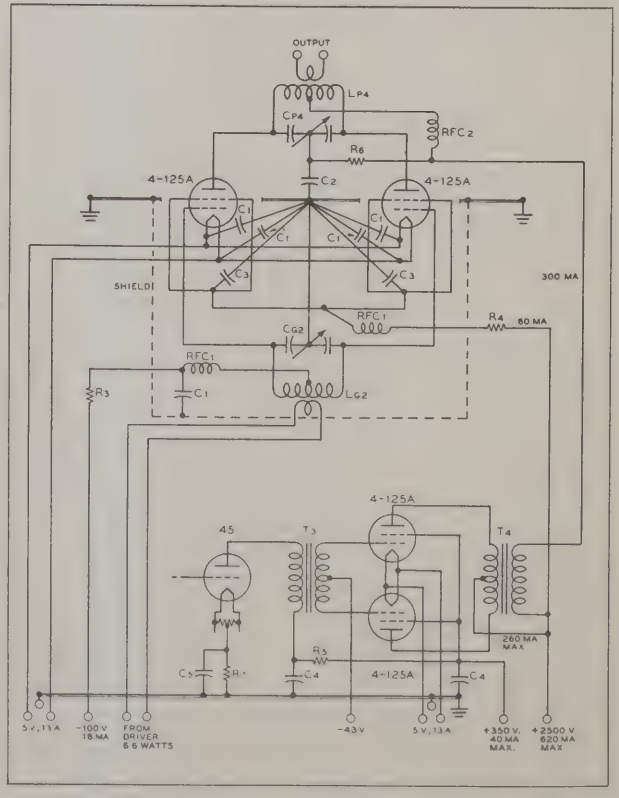


Ecc1	Ecc2	Pd	Ef	Ebb
D.C. GRID VOLTS	D.C. SCREEN VOLTS	DRIVING POWER	FILAMENT VOLTS	D.C PLATE VOLTS
−150 V., 24 MA	350 V., 80 MA.	7.6 WATTS	5.0 V.	2500 V., 400 MA.
−150 V., 18 MA.	350 V., 60 MA.	5.0 WATTS	5.0 V.	3000 V., 335 MA.

Typical radio-frequency power amplifier circuit, Class-C telegraphy, 1000 watts input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 380 watts plate input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 750 watts plate input.

See opposite page for list of components.

COMPONENTS FOR TYPICAL CIRCUITS

(Diagrams, Page 6)

L_{p1} - C_{p1} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p2} - C_{p2} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p3} - C_{p3} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{p4} - C_{p4} —Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{g1} - C_{g1} — Tuned circuit appropriate for operating frequency.

L_{g2} - C_{g2} — Tuned circuit appropriate for operating freqency.

C_1 — .002-ufd., 500-v. mica

C_2 — .002-ufd., 5000-v. mica

C_3 — .001-ufd., 2500-v. mica

C_4 — 16-ufd., 450-v. electrolytic

C_5 — 10-ufd., 25-v. electrolytic

R_1 — 7000 ohms, 5 watts

R_2 — 70,000 ohms, 100 watts

R_3 — 3500 ohms, 5 watts

R_4 — 35,000 ohms, 200 watts

R_5 — 560 ohms, 1 watt

R_6 — 25,000 ohms, 2 watts

R_7 — 1500 ohms, 5 watts

RFC_1 — 2.5-mhy., 125-ma. r-f choke

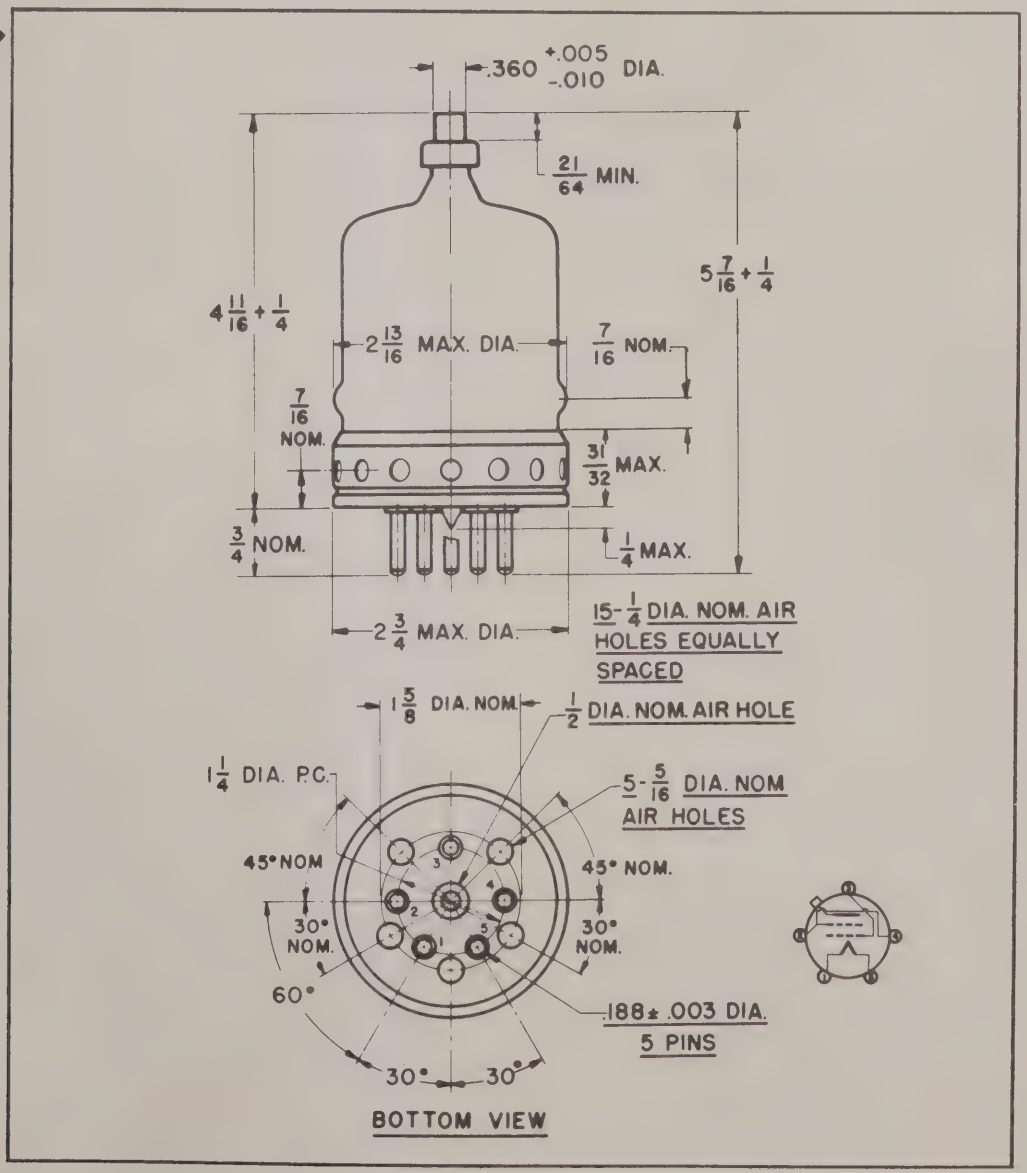
RFC_2 — 1-mhy., 500-ma. r-f choke

T_1 — 10-watt driver transformer; ratio pri. to ½ sec. approx. 2:1.

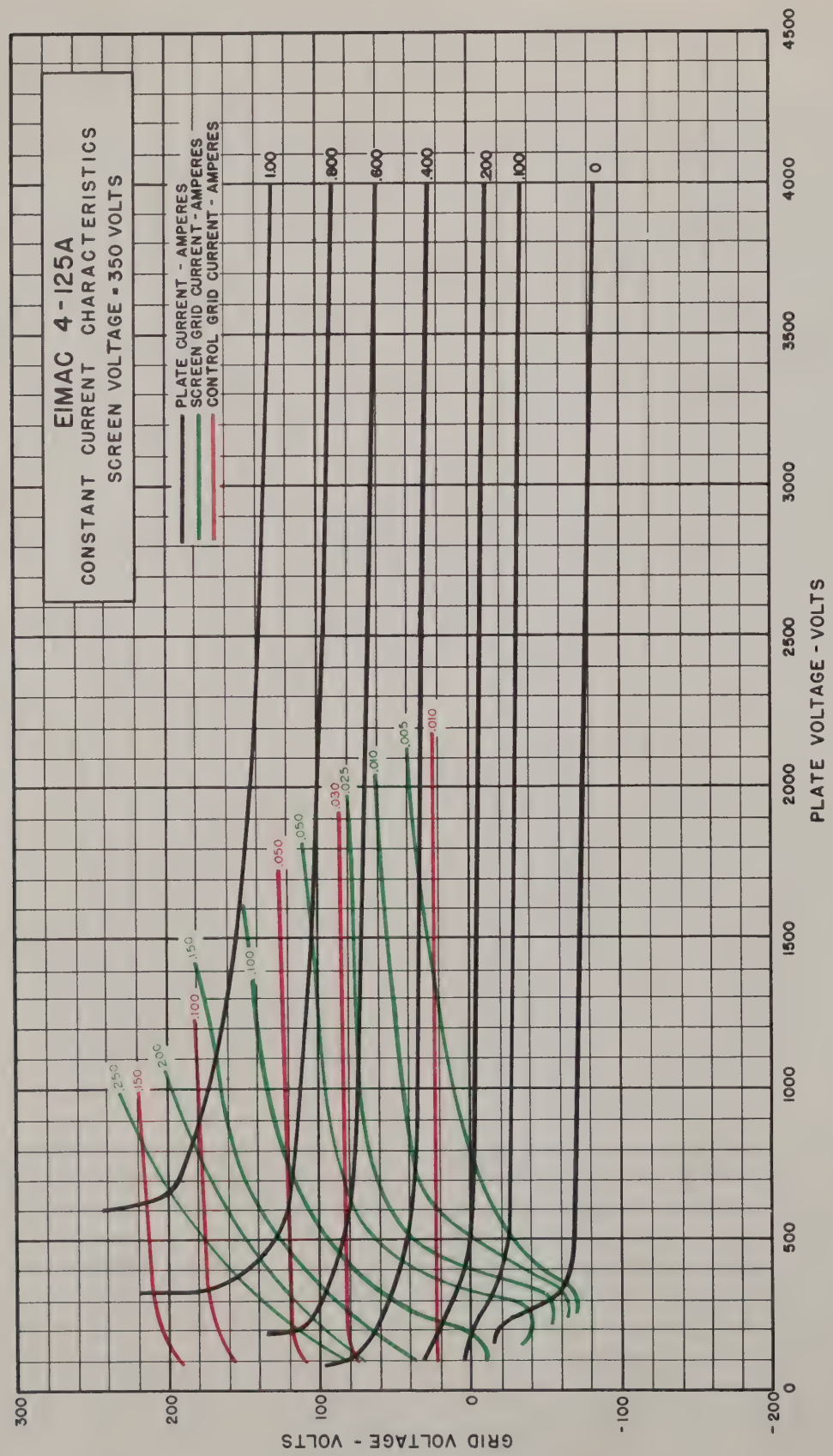
T_2 — 200-watt modulation transformer; ratio pri. to sec. approx. 1:1; pri. impedance = 16,200 ohms, sec. impedance = 16,500 ohms.

T_3 — 5-watt driver transformer; ratio pri. to ½ sec. approx. 1.1:1.

T_4 — 400-watt modulation transformer; ratio pri. to sec. approx. 2.7:1; pri. impedance = 22,200 ohms, sec. impedance = 8300 ohms.



▶ Indicates change from sheet dated 1-5-53



Printed in U. S. A. 10-86-82181

4-250A

(5D22)

RADIAL-BEAM POWER TETRODE

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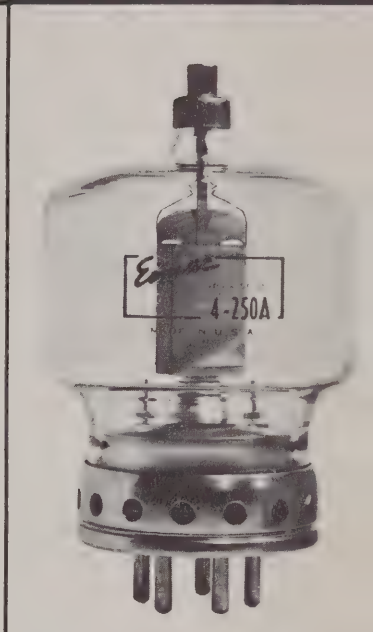
MODULATOR OSCILLATOR AMPLIFIER

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

The Eimac 4-250A is a compact, ruggedly constructed power tetrode having a maximum plate dissipation rating of 250 watts. It is intended for use as an amplifier, oscillator or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

The 4-250A is cooled by radiation from the plate and by circulation of forced-air through the base and around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Grid-Screen Amplification Factor (Average)	5.1
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.12 $\mu\mu$f
Input	12.7 $\mu\mu$f
Output	4.5 $\mu\mu$f
Transconductance (I_b = 100 ma., E_b = 2500V., E_{c2} = 500V.)	4000 μmhos
Frequency for Maximum Ratings	110 Mc.

MECHANICAL

Base	5-pin metal shell
Recommended Socket	E. F Johnson Co. socket No. 122-275, National Co. No. HX-100, or equivalent.
Basing	See drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Temperature of Base and Plate Seals — Base Seals	200° C.
Maximum Temperature of Base and Plate Seals — Plate Seal	170° C.
Maximum Over-all Dimensions — Length	6.38 inches
Maximum Over-all Dimensions — Diameter	3.56 inches
Net Weight	8.0 ounces
Shipping Weight	2.0 pounds

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C FM or Telegraphy (Key-down conditions, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 110 Mc.)

D-C Plate Voltage	2500	3000	4000 volts
D-C Screen Voltage	500	500	500 volts
D-C Grid Voltage	—150	—180	—225 volts
D-C Plate Current	300	345	312 ma
D-C Screen Current	60	60	45 ma
D-C Grid Current	9	10	9 ma
Screen Dissipation	30	30	22.5 watts
Grid Dissipation	0.35	0.8	0.46 watts
Peak R-F Grid Input Voltage (approx.)	220	265	303 volts
Driving Power (approx.)[2]	1.70	2.6	2.46 watts
Plate Power Input	750	1035	1250 watts
Plate Dissipation	175	235	250 watts
Plate Power Output	575	800	1000 watts

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony
(Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	3200 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	275 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 110 Mc.)

D-C Plate Voltage	2500	3000	volts
D-C Screen Voltage	400	400	volts
D-C Grid Voltage	—200	—310	volts
D-C Plate Current	200	225	ma
D-C Screen Current	30	30	ma
D-C Grid Current	9	9	ma
Peak A-F Screen Voltage (100% modulation)	350	350	volts
Screen Dissipation	12	12	watts
Grid Dissipation	1.8	2.7	watts
Peak R-F Grid Input Voltage (approx.)	255	365	volts
Driving Power (approx.)	2.2	3.2	watts
Plate Power Input	500	675	watts
Plate Dissipation	125	165	watts
Plate Power Output	375	510	watts

(Effective 7-15-55) Copyright 1952 by Eitel-McCullough, Inc.

[1]Above 110 Mc. the maximum plate voltage rating depends upon frequency. See page four.

[2]Driving power increases above 40 Mc. See page four.

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR—CLASS AB

MAXIMUM RATINGS (PER TUBE)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	350 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION CLASS AB_1

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	3000	volts
D-C Screen Voltage	600	600	600	600	volts
D-C Grid Voltage [1,2]	—95	—104	—110	—116	volts
Zero-Signal D-C Plate Current	120	110	120	120	ma
Max-Signal D-C Plate Current	400	405	430	417	ma
Zero-Signal D-C Screen Current	—0.4	—0.3	—0.3	—0.2	ma
Max-Signal D-C Screen Current	23	22	13	10.5	ma
Effective Load, Plate-to-Plate	6250	9170	11,400	15,000	ohms
Peak A-F Grid Input Voltage (per tube)	64	88	90	93	volts
Driving Power	0	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	145	175	225	250	watts
Max-Signal Plate Power Output	310	460	625	750	watts
Total Harmonic Distortion	4	2.5	2	2.5	per cent

[1]Adjust for stated zero-signal plate current.
[2]The effective grid-circuit resistance must not exceed 250,000 ohms.

TYPICAL OPERATION CLASS AB_2

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	3000	volts
D-C Screen Voltage	300	300	300	300	volts
D-C Grid Voltage[1]	—48	—48	—51	—53	volts
Zero-Signal D-C Plate Current	100	120	120	125	ma
Max-Signal D-C Plate Current	485	510	500	473	ma
Zero-Signal D-C Screen Current	0	0	0	0	ma
Max-Signal D-C Screen Current	34	26	23	33	ma
Effective Load, Plate-to-Plate	5400	8000	10,900	16,000	ohms
Peak A-F Grid Input Voltage (per tube)	96	99	100	99	volts
Max-Signal Avg. Driving Power (approx.)	2.1	2.3	2.2	1.9	watts
Max-Signal Peak Driving Power	4.7	5.5	4.8	4.6	watts
Max-Signal Plate Dissipation (per tube)	150	185	205	190	watts
Max-Signal Plate Power Output	428	650	840	1040	watts
Total Harmonic Distortion	3	4	4	4.5	per cent

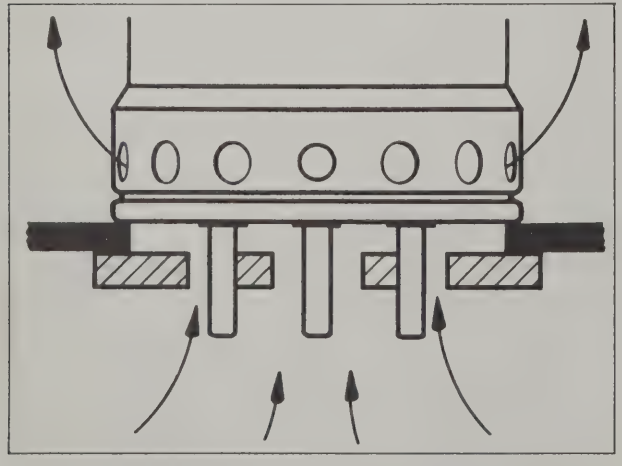
IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

Mechanical

Mounting—The 4-250A must be mounted vertically, base down or base up. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The tube should be mounted above the chassis deck to allow free circulation of air in the manner shown in the mounting diagram below. The above requirements are met by the E. F. Johnson Co. socket No. 122-275, the National Co. socket No. HX-100, or a similar socket.

A flexible connecting strap should be provided between the HR-6 Heat Dissipating Plate Connector on the plate terminal and the external circuit. The tube must be protected from severe vibration and shock.



4-250A mounting providing base cooling, shielding and isolation of output and input compartments.

▶ **Cooling**—Adequate cooling must be provided for the seals and envelope of the 4-250A. At frequencies above 30Mc, cooling air in the amount of five cubic feet per minute through the base of the tube is required. This quantity is obtained when the pressure drop across the base of the tube is equal to 0.20 inch of water column. At frequencies below 30Mc the volume may be reduced to two cubic feet per minute. At this reduced air flow, the pressure drop is equal to 0.10 inch of water column. Base-cooling air should be applied simultaneously with filament power. The temperature of the plate seal, as measured on the top of the plate cap, shou'd not exceed 170°C in continuous-service applications.

A relatively slow movement of air past the tube is sufficient to prevent a plate seal temperature in excess of the maximum rating at frequencies below 30 Mc. At frequencies above 30 Mc., radio-frequency losses in the leads and envelope contribute to seal and envelope heating and special attention should be given to bulb and plate seal cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 Mc. (The Eimac 4-400A Air-System Socket provides a convenient method of mounting and cooling the 4-250A at VHF, should the user desire to use it. Full information is available on the 4-400A Air-System Socket data sheet, or it will be sent from the factory on request.)

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten-minute period, plate-seal temperatures as high as 220° C. are permissible. When the ambient temperature does not exceed 30° C. it will not ordinarily be necessary to provide forced cooling of the bulb and plate seal to hold the temperature below this maximum at frequencies below 30 Mc., provided that a heat-radiating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded. The five cubic feet per minute base-cooling requirement must be observed in intermittent service.

Electrical

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the base pins, should be the rated value of 5.0 volts. Variations should be held within the range of 4.75 to 5.25 volts.

▶ Indicates change from sheet dated 8-24-53.

Bias Voltage—D-c bias voltage for the 4-250A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Grid Dissipation—Grid dissipation for the 4-250A should not be allowed to exceed ten watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation

e_{cmp} = Peak positive grid voltage, and

I_c = D-C grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid[3].

Screen Voltage—The d-c screen voltage for the 4-250A should not exceed 600 volts.

Screen Dissipation—The power dissipated by the screen of the 4-250A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load is removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in the event of circuit failure.

Plate Voltage—The plate-supply voltage for the 4-250A should not exceed 4000 volts for frequencies below 110 Mc. Above 110 Mc., the maximum permissible plate voltage is less than 4000 volt, as shown by the graph on page four.

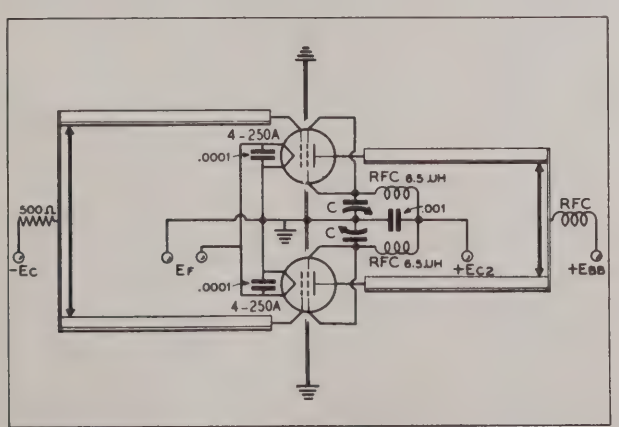
Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-250A should not be allowed to exceed 250 watts in unmodulated applications.

In plate-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 165 watts.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

Operation

Class-C FM or Telegraphy—The 4-250A may be operated as a class-C amplifier, FM or telegraphy, without neutralization up to 30 Mc. if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. A grounded metallic plate on which the socket may be mounted and to which suitable connectors may be attached to ground the tube base shell, provides an effective isolating shield between grid and plate circuits. In single-ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier in order to minimize grid-plate coupling between these leads external to the amplifier.



Screen-tuning neutralization circuit for use above 45 Mc.
C — Approximately 100µµfd. per section, maximum.

At frequencies from 30 Mc. to 45 Mc. ordinary neutralization systems may be used.

Where shielding is adequate, the feed-back at frequencies above 45 Mc. is due principally to screen-lead-inductance effects, and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately ¾-inch square connected to the grid terminal and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope. An alternative neutralization scheme is illustrated in the diagram below. In this circuit, feed-back is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together, as shown on the diagram, by the shortest possible lead, and the leads from the screen terminal to the capacitor, C, and from the capacitor to ground should be made as short as possible.

Driving power and power output under maximum output and plate voltage conditions are shown on page 4. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirement by a sufficient margin to allow for coupling-circuit losses. The use of silver-plated linear tank-circuit elements is recommended for all frequencies above 110 Mc.

Class-C AM Telephony—The r-f circuit considerations discussed above under Class-C FM or Telegraphy also apply to amplitude-modulated operation of the 4-250A. When the 4-250A is used as a class-C plate-modulated amplifier, modulation should be applied to both plate and screen. Modulation voltage for the screen may be obtained from a separate winding on the modulation transformer, by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead. When screen modulation is obtained by either the series-resistor or the audio-reactor method, the audio-frequency variations in screen current which result from the variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two or three times the operating d-c screen current. To prevent phase shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate r-f by-passing.

For plate-modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

Class-AB_1 and Class-AB_2 Audio—Two 4-250A's may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB_1 and class-AB_2 audio operation are given in the tabulated data.

Screen voltage should be obtained from a source having reasonably good regulation to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit should provide adequate regulation.

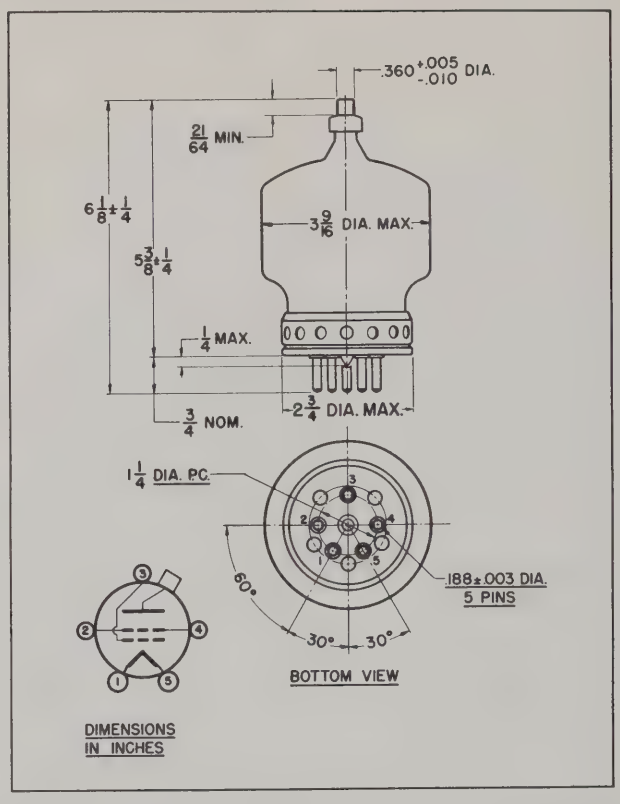
Grid bias voltage for class-AB_2 service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB_1 conditions the effective grid-circuit resistance should not exceed 250,000 ohms.

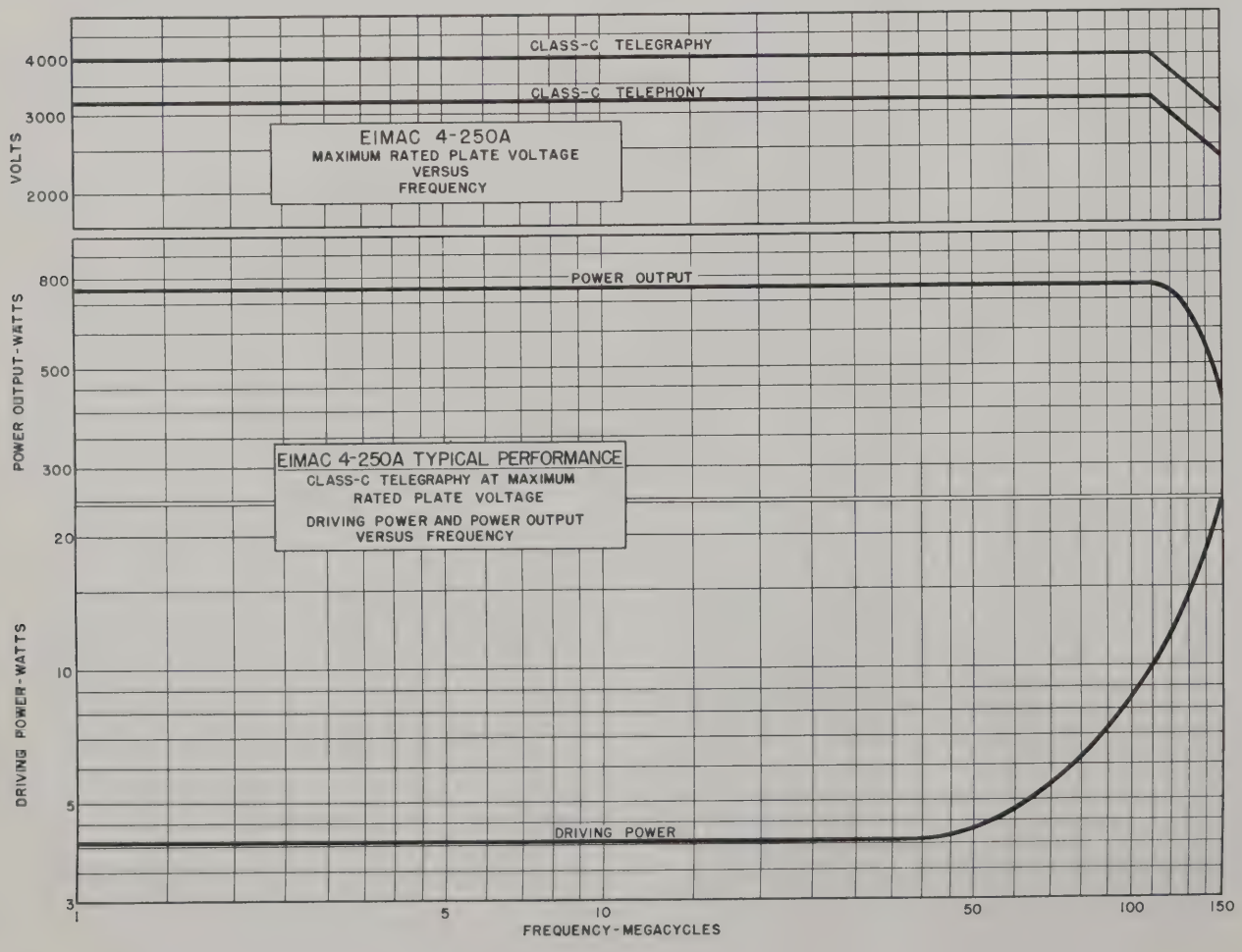
[3] For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," **Eimac News**, January, 1945. This article is available in reprint form on request.

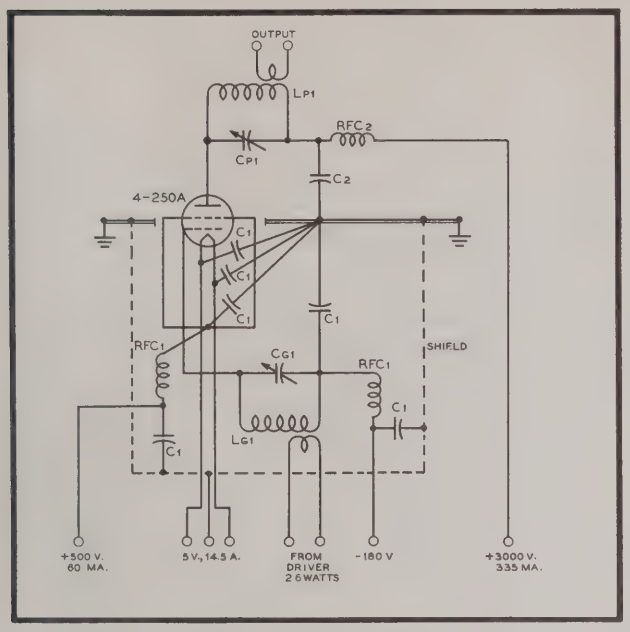
The peak driving power figures given in the class-AB_2 tabulated data are included to make possible an accurate determination of the required driver output power. The driver amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

In some cases the maximum-signal plate dissipation shown under "Typical Operation" is less than the maximum rated plate dissipation of the 4-250A. In these cases, the plate dissipation reaches a maximum value, equal to the maximum rating, at a point somewhat below maximum-signal conditions.

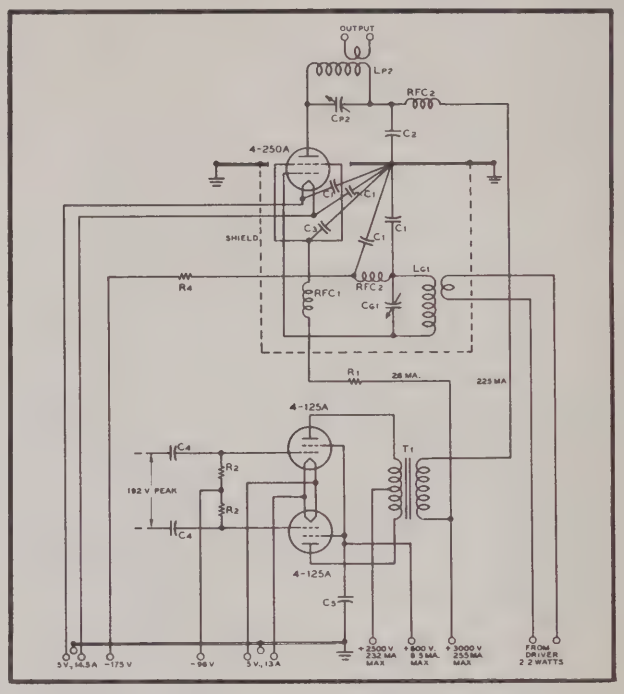
The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.



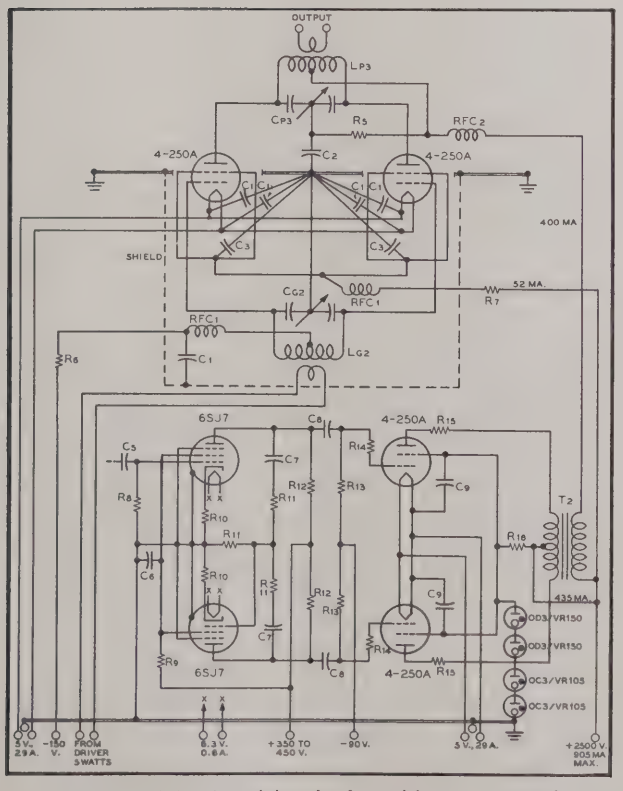




Typical radio frequency power amplifier circuit, Class-C telegraphy, 1000 watts input.



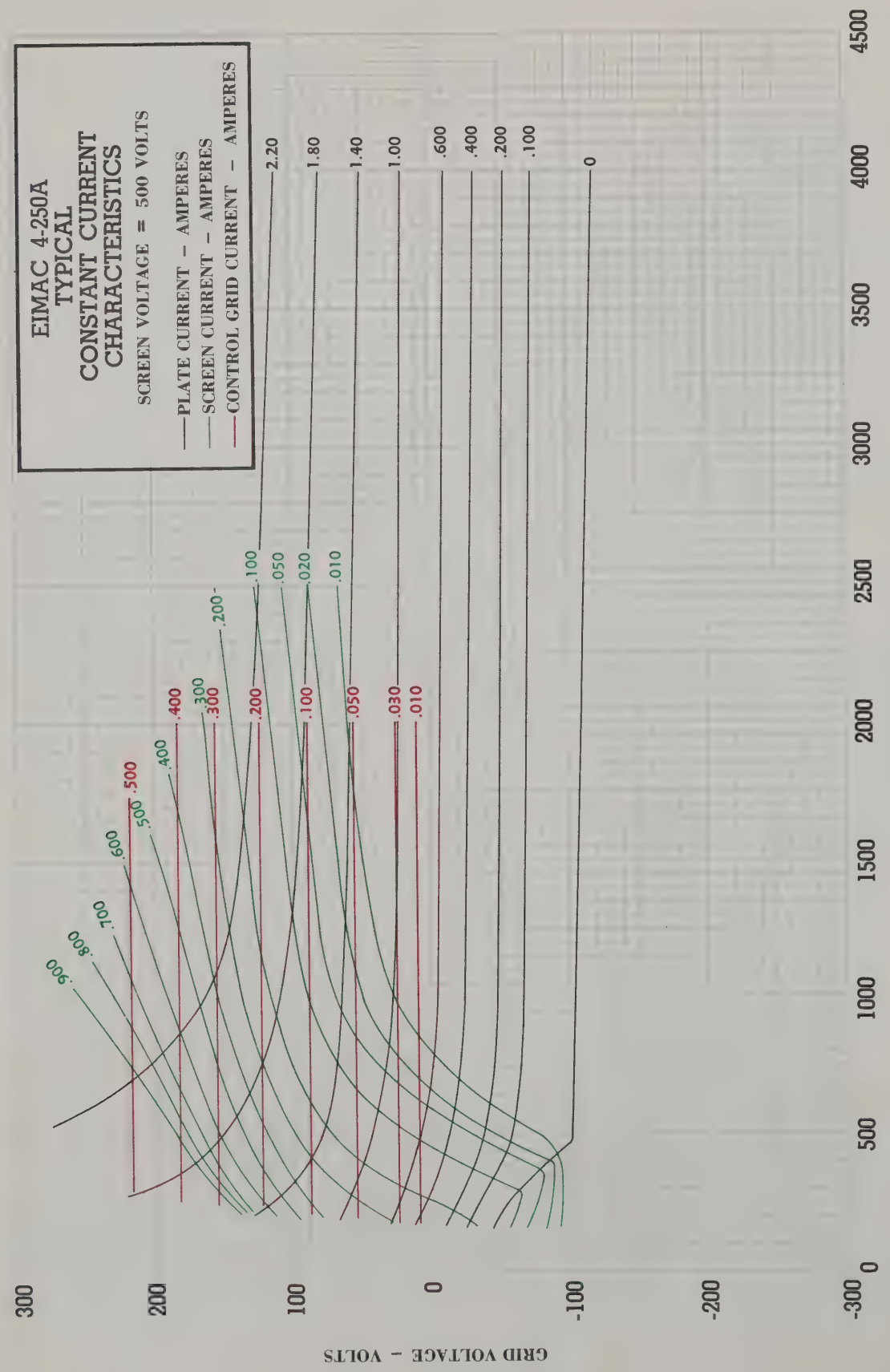
Typical high-level-modulated r-f amplifier circuit, with modulator stage, 675 watts input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 1000 watts input.

COMPONENTS FOR TYPICAL CIRCUITS

L_{p1} - C_{p1} — Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".
L_{p2} - C_{p2} — Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".
L_{p3} - C_{p3} — Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".
L_{g1} - C_{g1} — Tuned circuit appropriate for operating frequency.
L_{g2} - C_{g2} — Tuned circuit appropriate for operating frequency.
C_1 — .002-ufd. 500-v. mica
C_2 — .002-ufd. 5000-v mica
C_3 — .001-ufd., 2500-v. mica
C_4 — .1-ufd., 1000-v. paper
C_5 — .1-ufd. 600-v. paper
C_6 — .5-ufd. 600-v paper
C_7 — .03-ufd., 600-v. paper
C_8 — .1-ufd., 1000-v. paper
C_9 — .25-ufd., 1000-v. paper
R_1 — 86,700 ohms, adjustable 100,000 ohms, 100 watts
R_2 — 250,000 ohms, 1/2 watt
R_4 — 15,000 ohms, 5 watts
R_5 — 25,000 ohms, 2 watts
R_6 — 2,500 ohms, 5 watts
R_7 — 35,000 ohms, 160 watts
R_8 — 250,000 ohms, 1/2 watt
R_9 — 200,000 ohms, 2 watts
R_{10} — 500 ohms, 1/2 watt
R_{11} — 1 megohm, 1/2 watt
R_{12} — 100,000 ohms, 1 watt
R_{13} — 200,000 ohms, 1/2 watt
R_{14} — 10,000 ohms, 1/2 watt
R_{15} — 50 ohms, 10 watts
R_{16} — 100,000 ohms, 100 watts
RFC_1 — 2.5-mhy., 125-ma. r-f choke
RFC_2 — 1-mhy., 500-ma. r-f choke
T_1 — 350-watt modulation transformer; ratio pri. to sec. approx. 1.5 : 1; pri. impedance 20,300 ohms, sec. impedance 13,300 ohms.
T_2 — 600-watt modulation transformer; ratio pri. to sec. approx. 1.8 : 1; pri. impedance 11,400 ohms, sec. impedance 6,250 ohms.



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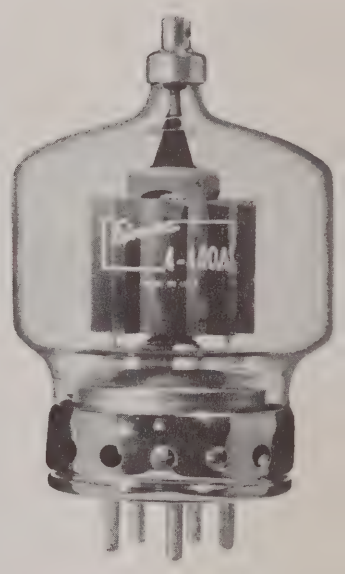
SAN BRUNO, CALIFORNIA

4-400A

RADIAL-BEAM POWER TETRODE

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MODULATOR OSCILLATOR AMPLIFIER



The Eimac 4-400A is a compact, ruggedly constructed power tetrode having a maximum plate dissipation rating of 400 watts. It is intended for use as an amplifier, oscillator or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

The 4-400A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an Eimac 4-400A/4000 Air-System Socket and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.†

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Grid-Screen Amplification Factor (Average)	5.1
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.12 $\mu\mu$fd
Input	12.5 $\mu\mu$fd
Output	4.7 $\mu\mu$fd
Transconductance (I_b=100ma., E_b=2500V., E_{c2}=500V.)	4,000 μmhos
Frequency for Maximum Ratings	110 Mc.

MECHANICAL

Base	See drawing
Basing	See drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Recommended Socket	Eimac 4-400A/4000 Air-System Socket
Maximum Over-all Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Net Weight	9 ounces
Shipping Weight	2.5 pounds

If an Air-System Socket is used, mounted on a 1/4 inch deck, the over-all dimensions of the system including chimney and HR-6 Heat Dissipating Plate Connector are:

Length	8.0 inches
Diameter	5.5 inches

▶ **Note:** Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS (Key-down conditions, per tube to 110 Mc.)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA
PLATE DISSIPATION	400 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc., one tube)

D-C Plate Voltage	2500	3000	4000 volts
D-C Screen Voltage	500	500	500 volts
D-C Grid Voltage	—200	—220	—220 volts
D-C Plate Current	350	350	350 ma
D-C Screen Current	46	46	40 ma
D-C Grid Current	18	19	18 ma
Screen Dissipation	23	23	20 watts
Grid Dissipation	1.8	1.9	1.8 watts
Peak R-F Grid Input Voltage	300	320	320 volts
Driving Power*	5.4	6.1	5.8 watts
Plate Power Input	875	1050	1400 watts
Plate Dissipation	235	250	300 watts
Plate Power Output	640	800	1100 watts

*Driving Power increases as frequency is increased. At 75 Mc. the driving power required is approximately 12 watts.

TYPICAL OPERATION (110 Mc., two tubes)

D-C Plate Voltage	3500	4000 volts
D-C Screen Voltage	500	500 volts
D-C Grid Voltage	—170	—170 volts
D-C Plate Current	500	540 ma
D-C Screen Current	34	31 ma
D-C Grid Current	20	20 ma
Driving Power (approx.)	20	20 watts
Plate Power Output (approx.)	1300	1600 watts
Useful Power Output	1160	1440 watts

†Guarantee applies only when the 4-400A is used as specified with adequate air in the 4-400A/4000 Air-System Socket or equivalent.

(Effective 1-15-55) Copyright 1955 by Eitel-McCullough, Inc.

▶ Indicates change from sheet dated 1-30-53.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions unless otherwise specified. One tube)

MAXIMUM RATINGS (Frequencies below 75 Mc. Continuous Service)

D-C PLATE VOLTAGE	3200 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	275 MAX. MA
PLATE DISSIPATION	270 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc. Continuous Service)

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	—220	—220	—220	volts
D-C Plate Current	275	275	275	ma
D-C Screen Current	30	28	26	ma
D-C Grid Current	12	12	12	ma
Screen Dissipation	15	14	13	watts
Grid Dissipation	1.1	1.1	1.1	watts
Peak A-F Screen Voltage (100% modulation)	350	350	350	volts
Peak R-F Grid Input Voltage	290	290	290	volts
Driving Power	3.5	3.5	3.5	watts
Plate Power Input	550	688	825	watts
Plate Dissipation	170	178	195	watts
Plate Power Output	380	510	630	watts

▶ MAXIMUM RATINGS (Frequencies below 30 Mc., Intermittent Service)

D-C Plate Voltage	4000 MAX. VOLTS
D-C Screen Voltage	600 MAX. VOLTS
D-C Grid Voltage	—500 MAX. VOLTS
D-C Plate Current	275 MAX. MA
Plate Dissipation	270 MAX. WATTS
Screen Dissipation	35 MAX. WATTS
Grid Dissipation	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc., Intermittent Service)

D-C Plate Voltage	2000	2500	3000	3650	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage	—220	—220	—220	—225	volts
D-C Plate Current	275	275	275	275	ma
D-C Screen Current	30	28	26	23	ma
D-C Grid Current	12	12	12	13	ma
Screen Dissipation	15	14	13	12	watts
Grid Dissipation	1.1	1.1	1.1	1.2	watts
Peak A-F Screen Voltage (100% modulation)	350	350	350	350	volts
Peak R-F Grid Input Voltage	290	290	290	315	volts
Driving Power	3.5	3.5	3.5	4.0	watts
Plate Power Input	550	688	825	1000	watts
Plate Dissipation	170	178	195	235	watts
Plate Power Output	380	510	630	765	watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR—CLASS AB

MAXIMUM RATINGS (PER TUBE)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	800 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	350 MAX. MA.
PLATE DISSIPATION	400 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION CLASS AB_1

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	2500	3000	3500	4000	volts
D-C Screen Voltage	750	750	750	750	volts
D-C Grid Voltage (approx.)*	—130	—137	—145	—150	volts
Zero-Signal D-C Plate Current	190	160	140	120	ma
Max-Signal D-C Plate Current	635	635	610	585	ma
Zero-Signal D-C Screen Current	0	0	0	0	ma
Max-Signal D-C Screen Current	28	26	32	40	ma
Effective Load, Plate-to-Plate	6800	8900	11,500	14,500	ohms
Peak A-F Grid Input Voltage (per tube)	130	137	145	150	volts
Driving Power	0	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	370	400	400	400	watts
Max-Signal Plate Power Output	850	1110	1330	1540	watts

*Adjust to give stated zero-signal plate current. The D-C resistance in series with the control grid of each tube should not exceed 250,000 ohms.

TYPICAL OPERATION CLASS AB_2

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	2500	3000	3500	4000	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage (approx.)*	—75	—80	—85	—90	volts
Zero-Signal D-C Plate Current	190	160	140	120	ma
Max-Signal D-C Plate Current	700	700	700	638	ma
Zero-Signal D-C Screen Current	0	0	0	0	ma
Max-Signal D-C Screen Current	50	40	38	32	ma
Effective Load, Plate-to-Plate	7200	9100	10,800	14,000	ohms
Peak A-F Grid Input Voltage (per tube)	133	140	145	140	volts
Max-Signal Peak Driving Power	8.6	9.0	10.2	7.0	watts
Max-Signal Nominal Driving Power	4.3	4.5	5.1	3.5	watts
Max-Signal Plate Dissipation (per tube)	320	363	400	400	watts
Max-Signal Plate Power Output	1110	1375	1650	1750	watts

*Adjust for stated zero-signal plate current.

Pulse Service—For information on Pulse Service Ratings, "Application Bulletin No. 3, Pulse Service Notes", will be furnished free on request.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting—The 4-400A must be mounted vertically, base up or base down. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the Eimac 4-400A/4000 Air-System Socket. A flexible connecting strap should be provided between the Eimac HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling—Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C., and the plate seal at a temperature below 225°C.

When the Eimac 4-400A/4000 Air-System Socket is used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water, as measured in the socket at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

In the event an Air-System Socket is not used, pro-

▶ Indicates change from sheet dated 1-30-53.

vision must be made to supply equivalent cooling of the base, the envelope, and the plate lead.

▶ Tube temperatures may be measured with the aid of "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 11 West 25th Street, New York 10, N. Y.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 5.0 volts. Variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage—The d-c bias voltage for the 4-400A should not exceed 500 volts. If grid leak bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 Mc., it is advisable to keep the bias voltage as low as is practicable.

Screen Voltage—The d-c screen voltage for the 4-400A should not exceed 600 volts in r-f applications. In audio applications a maximum d-c screen voltage of 800 volts may be used. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

Plate Voltage—The plate-supply voltage for the 4-400A should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the d-c plate-supply voltage should not exceed 3200 volts, except below 30 Mc., intermittent service, where 4000 volts may be used.

Grid Dissipation—Grid dissipation for the 4-400A should not be allowed to exceed 10 watts. Grid dissipation may be calculated from the following expression,

$$P_g = e_{cmp} I_c$$

where P_g = Grid Dissipation
e_{cmp} = Peak positive grid to cathode voltage, and
I_c = D-c grid current

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. (For suitable peak v.t.v.m. circuits see Eimac Application Bulletin Number 6, "Vacuum Tube Ratings." This bulletin is available on request.)

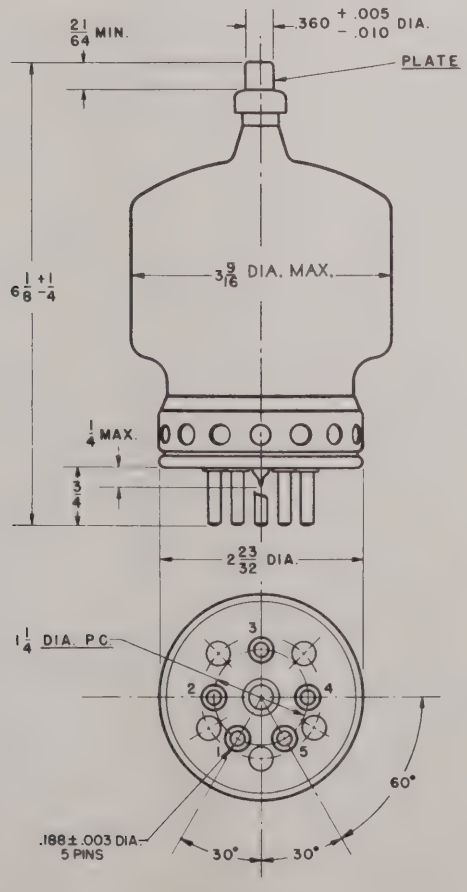
Screen Dissipation—The power dissipated by the screen of the 4-400A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 35 watts in event of circuit failure.

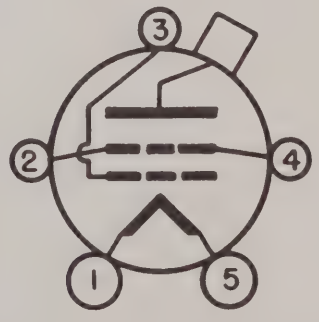
Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-400A should not be allowed to exceed 400 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

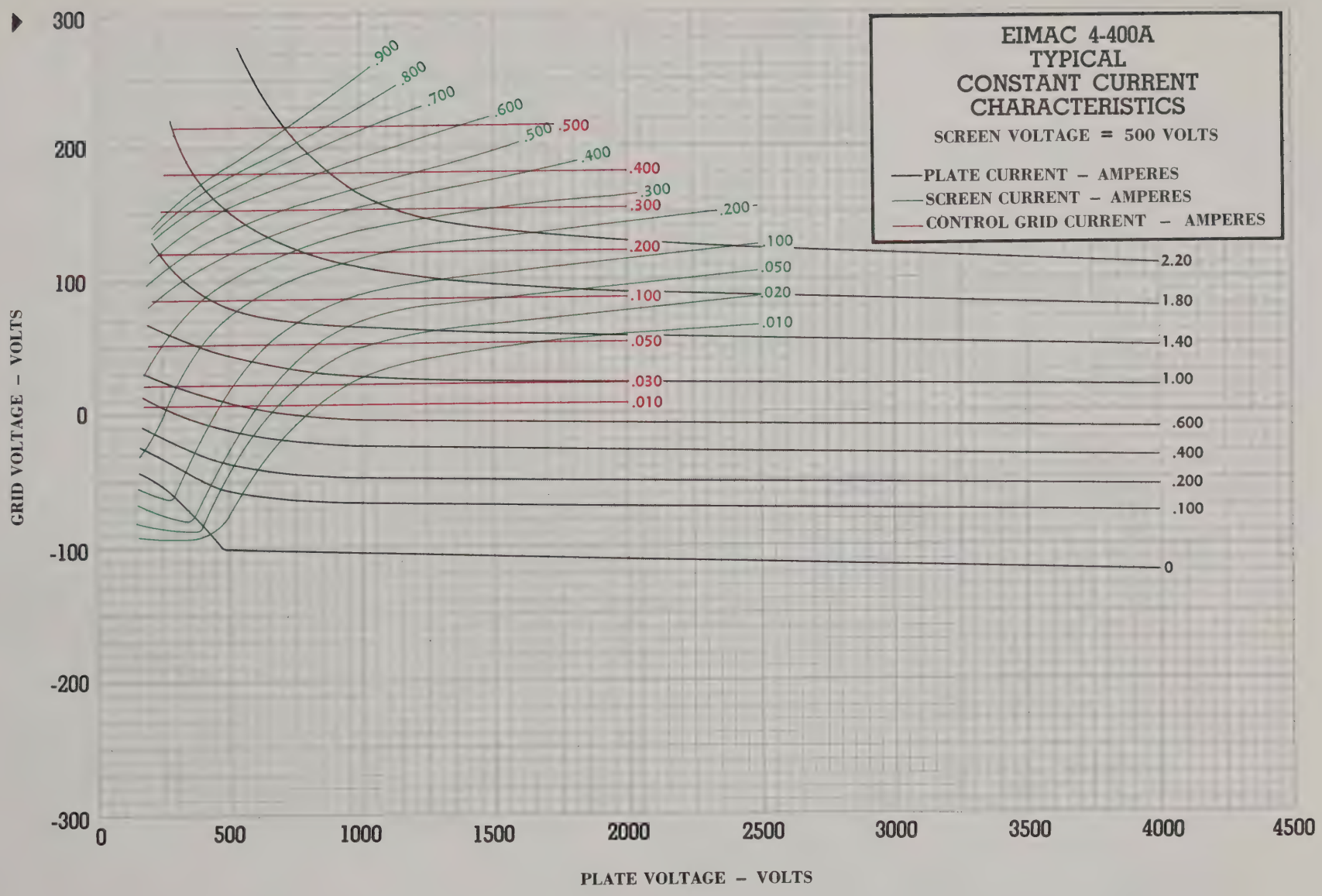
Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

GENERAL INFORMATION PERTAINING TO THE OPERATION OF THE 4-400A MAY BE FOUND IN APPLICATION BULLETIN NO. 8, "THE CARE AND FEEDING OF POWER TETRODES." THIS BULLETIN IS AVAILABLE UPON REQUEST.





▶ Indicates change from sheet dated 1-30-53.



Eimac 4-400A

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▶ Indicates change from sheet dated 1-30-53.

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4-400A/4000

AIR-SYSTEM SOCKET



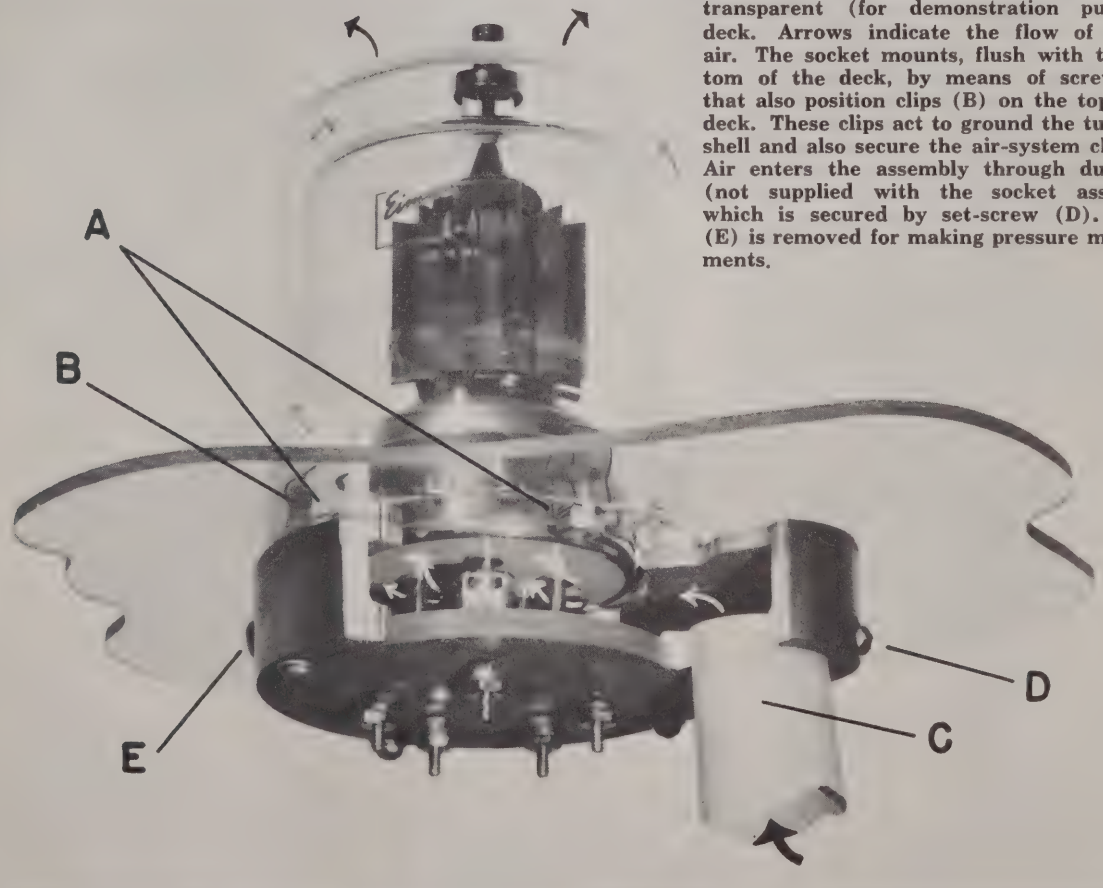
To simplify cooling of the Eimac 4-400A tetrode and assure adequate air flow to the various seals, the Eimac Air-System Socket 4-400A/4000 was developed. This system is so designed that the correct amount of cooling air is distributed to the various seals in the right proportion.

The Air-System Socket is comprised of a socket to support the 4-400A tetrode and to make the necessary base connections, clips for grounding the base shell, and a glass manifold to direct air flow to the plate terminal. The air enters the bottom of the socket through a 1¼-inch duct, cools the base terminals, flows through the base of the tube, is guided by a pyrex chimney past the glass envelope, and is directed against the plate terminal heat dissipating connector. A minimum quantity of air is thereby used effectively to cool the tube adequately under the severest requirements of the tube's rating.

A flow of 14 CFM of air is required at an inlet static pressure of ¼" of water. The blower must be capable of supplying these requirements and also whatever added pressure drop is introduced by the connecting ducts and air filters. These air requirements are readily satisfied by a small centrifugal blower driven by a motor requiring less than 50 watts of power.

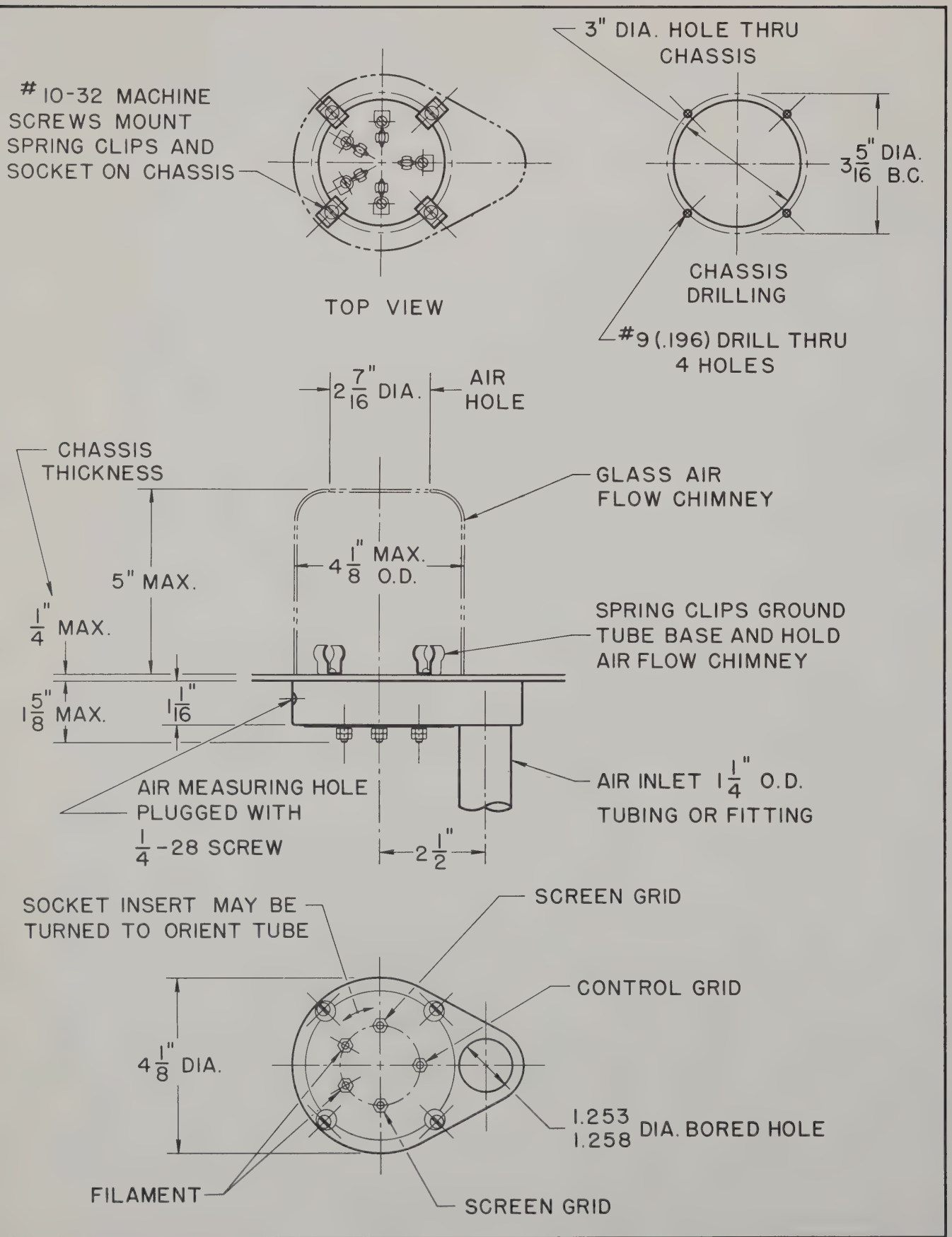
These air figures are based on sea-level operation with an ambient temperature of 25°C. and for amplifier operation at 110 Mc. where the r-f charging current into the plate-screen capacitance is most severe. Cooling the 4-400A with this socket as recommended will keep all base seals below the maximum allowable temperature limit of 200°C. and the plate seal below the allowable limit of 225°C. Determination of the proper flow of air can be made by measuring the pressure existing in the socket housing. A ¼ inch hole, tapped with 28 threads per inch is provided to make connection to a water manometer. The static pressure at this point is ¼ inch of water when 14 CFM is flowing. The manometer tube probe should be flush with the inside surface of the socket manifold.

The 4-400A/4000 Air-System Socket can also be used without modification for the Eimac 4-250A and 4-125A tetrodes.



Looking up on a cutaway socket mounted on transparent (for demonstration purposes) deck. Arrows indicate the flow of cooling air. The socket mounts, flush with the bottom of the deck, by means of screws (A) that also position clips (B) on the top of the deck. These clips act to ground the tube base shell and also secure the air-system chimney. Air enters the assembly through duct (C), (not supplied with the socket assembly) which is secured by set-screw (D). Screw (E) is removed for making pressure measurements.

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Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

4-1000A

RADIAL-BEAM POWER TETRODE

•

MODULATOR OSCILLATOR AMPLIFIER



The Eimac 4-1000A is a radial-beam tetrode with a maximum plate dissipation rating of 1000 watts. Intended for use as an amplifier, oscillator, or modulator, the 4-1000A is capable of efficient operation well into the VHF range.

In FM broadcast service on 110 Megacycles, two 4-1000A tetrodes will deliver a useful output power of over 5000 watts.

Operating under class AB_2 modulator conditions with less than 10 watts of peak driving power, two of these tubes will deliver 3900 watts of output power.

In class AB_1, a pair of 4-1000A tetrodes will deliver 3800 watts of output power.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified through the use of the Eimac SK-500 Air-System Socket.

GENERAL CHARACTERISTICS

▶ ELECTRICAL

	Min.	Nom.	Max	
Filament: Thoriated tungsten				
Voltage	-	7.5		volts
Current	20.0		22.7	amperes
Amplification Factor (Grid to Screen)	6.1		7.7	
Direct Interelectrode Capacitances: †				
Grid-Plate	-	-	0.35	uuf
Input	23.8		32.4	uuf
Output	6.8		9.4	uuf
Transconductance (I_b=300 ma)		10,000		umhos
Highest Frequency for Maximum Ratings	-	-	110	mc

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommended Socket	Eimac SK 500 Air-System Socket
Operating Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Connector:	
Plate	Eimac HR-8
Maximum Over-all Dimensions:	
Length	9.63 inches
Diameter	5.25 inches
Net Weight (tube only)	1.5 pounds
Shipping Weight	12 pounds

†In Shielded Fixture

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed there will be little variation in output power between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, it is necessary to make the resistor adjustable to control plate current.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS (Key-down conditions, per tube to 110 Mc.)

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	700 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

TYPICAL OPERATION (Frequencies below 110 Mc., one tube)

D-C Plate Voltage	3000	4000	5000	6000	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage	—150	—150	—200	—200	volts
D-C Plate Current	700	700	700	700	ma
D-C Screen Current	146	137	147	140	ma
D-C Grid Current	38	39	45	42	ma
Screen Dissipation	73	69	73	70	watts
Grid Dissipation	5	6	7	6	watts
Peak R-F Grid Input Voltage (approx.)	290	290	355	350	volts
Driving Power (approx.)*	11	12	16	15	watts
Plate Input Power	2100	2800	3500	4200	watts
Plate Dissipation	670	700	690	800	watts
Plate Output Power	1430	2100	2810	3400	watts

*Apparent driving power requirements increase above 30 Mc. At 110 Mc. the driver should be capable of supplying 200 watts per tube to take care of feed-through, circuit losses, and radiation.

TYPICAL OPERATION (110 Mc., two tubes, push-pull)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	450	500	500	volts
D-C Grid Voltage	—150	—160	—180	volts
D-C Plate Current	1.15	1.25	1.25	amps
D-C Screen Current	280	240	250	ma
D-C Grid Current	80	80	100	ma
Screen Dissipation (per tube)	63	60	63	watts
Driving Power (approx.)	350	400	400	watts
Plate Input Power	4600	6250	7500	watts
Plate Dissipation (per tube)	650	850	900	watts
Useful Output Power	3000	4200	5200	watts

These 110 Mc. typical performance figures were obtained by direct measurement in operating equipment. The output power is useful power measured in a load circuit. The driving power is that taken by the tube and a practical resonant circuit. In many cases with further refinement and improved techniques, better performance might be obtained.

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▶ Indicates change from sheet dated 3-1-56

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS (Per tube to 110 Mc.)

D-C PLATE VOLTAGE	5000 MAX. VOLTS†
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA
PLATE DISSIPATION	670 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

†5500 Max. volts below 30 Mc.

TYPICAL OPERATION (Frequencies below 110 Mc., one tube)

D-C Plate Voltage	3000	4000	5000	5500*	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage	—200	—200	—200	—200	volts
D-C Plate Current	600	600	600	600	ma
D-C Screen Current	145	132	130	105	ma
D-C Grid Current	36	33	33	28	ma
Screen Dissipation	72	66	65	52	watts
Grid Dissipation	5	4	4	3	watts
Peak A.F. Screen Voltage (100% modulation)	250	250	250	250	volts
Peak R-F Grid Input Voltage	340	335	335	325	volts
Driving Power**	12	11	11	9	watts
Plate Input Power	1800	2400	3000	3300	watts
Plate Dissipation	410	490	560	670	watts
Plate Output Power	1390	1910	2440	2630	watts

*5500 volt operation may be used below 30 Mc only.

**Apparent driving power requirements increase above 30 Mc. At 110 Mc. the driver should be capable of supplying 200 watts per tube to take care of feed-through, circuit losses, and radiation.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class AB

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	700 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION

Class AB_1 (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	1000	1000	1000	volts
D-C Grid Voltage (approx.)*	—115	—125	—135	volts
Zero-Signal D-C Plate Current	300	240	200	ma
Max-Signal D-C Plate Current	1.05	1.00	0.95	amps
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	60	60	64	ma
Effective Load, Plate-to-Plate	7000	10,000	14,000	ohms
Peak A-F Grid Input Voltage (per tube)	115	125	135	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	930	950	930	watts
Max-Signal Plate Output Power	2340	3100	3840	watts

*Adjust to give stated zero-signal plate current. The D-C resistance in series with the control grid of each tube should not exceed 250,000 ohms.

TYPICAL OPERATION

Class AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage (approx.)*	—60	—70	—75	volts
Zero-Signal D-C Plate Current	300	200	150	ma
Max-Signal D-C Plate Current	1.20	1.10	.95	amps
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	95	90	65	ma
Effective Load, Plate-to-Plate	7000	11,000	15,000	ohms
Peak A-F Grid Input Voltage (per tube)	140	145	130	volts
Max-Signal Peak Driving Power	11.0	11.0	9.4	watts
Max-Signal Nominal Driving Power (approx.)	5.5	5.5	4.7	watts
Max-Signal Plate Dissipation (per tube)	900	850	900	watts
Max-Signal Plate Output Power	3000	3800	3900	watts

*Adjust to give stated zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATON AND RECOMMENDATIONS

APPLICATION

MECHANICAL

Mounting—The 4-1000A must be operated vertically. The base may be down or up. The recommended socket for this tube is the SK-500 Air-System Socket.

Cooling—Adequate forced-air cooling must be provided to maintain the base seal temperatures below 150°C and the plate seal temperature below 200°C. Cooling is simplified by the use of the Eimac SK-500 Air System Socket, and its SK-506 Air Chimney, which control the flow of air around the tube.

When the Eimac SK-500 Air-System Socket is used, the following flow rates apply to sea level operation, with an ambient temperature of 25°C for the operating conditions described:

At 110 megacycles, with maximum rated plate dissipation, an air-flow rate of 45 cfm is required. The corresponding pressure drop across the socket is 1.2 inches of water column.

At frequencies below 30 megacycles, an air-flow rate of 30 cfm provides adequate cooling. The corresponding pressure drop across the socket is 0.5 inch of water column.

In the event that an Air-System Socket and Air Chimney are not used, air must be circulated through the base of the tube and over the envelope surface and the plate seal in sufficient quantities to maintain the temperatures below the maximum ratings. Seal-temperature ratings may require that cooling air be supplied to the tube if the filament is maintained at operating temperature during standby periods.

In any questionable situation, the only criterion for correct cooling practice is temperature. A convenient medium for measuring tube temperatures is a temperature-sensitive paint.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 7.5 volts. Variations in filament voltage must be kept within the range of 7.13 to 7.87 volts.

Bias Voltage—The d-c bias voltage for the 4-1000A should not exceed 500 volts. With grid-leak bias, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation. The grid-resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In the case of operation above 50 megacycles, it is advisable to keep the bias voltage as low as possible.

Screen Voltage—The d-c screen voltage for the 4-1000A should not exceed 1000 volts. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

Plate Voltage—The plate-supply voltage for the 4-1000A should not exceed 6000 volts in CW and audio applications. In plate-modulated telephony service above 30 megacycles, the d-c plate-supply voltage should not exceed 5000 volts; however, below 30 megacycles, 5500-volts may be used.

Grid Dissipation—Grid dissipation for the 4-1000A should not be allowed to exceed 25 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where: P_g = Grid dissipation,
e_{cmp} = Peak positive grid to cathode voltage
I_c = D-C grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.

Screen Dissipation—The power dissipated by the screen of the 4-1000A must not exceed 75 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 75 watts in event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-1000A should not be allowed to exceed 1000 watts.

In plate-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 670 watts. The plate dissipation will rise to 1000 watts under 100 per-cent sinusoidal modulation.

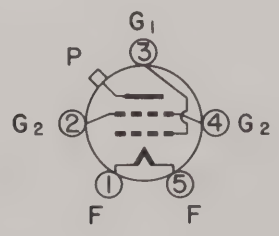
Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

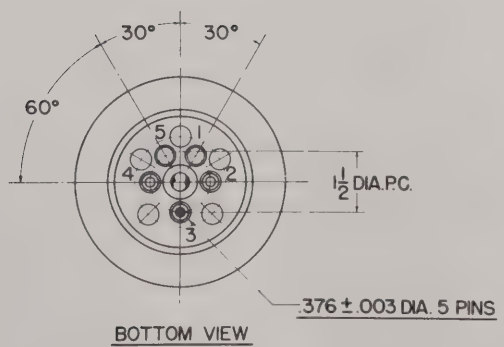
Neutralization—If reasonable precautions are taken to prevent coupling between input and output circuits, the 4-1000A may be operated up to the 10-megacycle region without neutralization. In the region between 10 megacycles and 30 megacycles, the conventional type of cross-neutralizing may be used with push-pull circuits. In single-ended circuits ordinary neutralization systems may be used which provide 180° out of phase voltage to the grid.

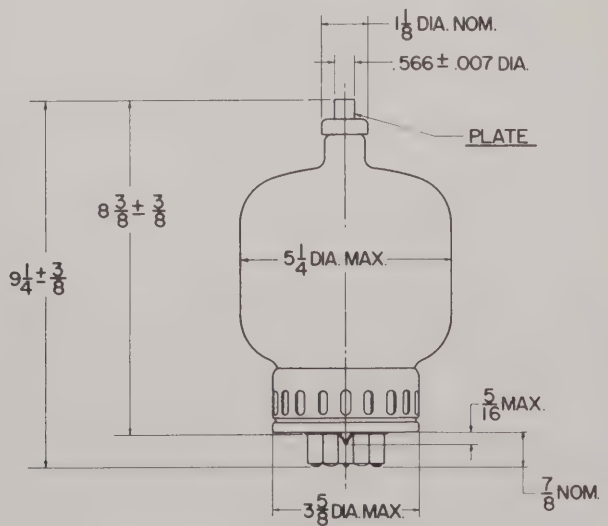
At frequencies above 30 megacycles the feedback is principally due to screen-lead-inductance effects. Feedback is eliminated by using series capacitance in the screen leads between the screen and ground. A variable capacitor of from 25 to 50 uufds will provide sufficient capacitance to neutralize each tube in the region of 100 megacycles. When using this method, the two screen terminals on the socket should be strapped together by the shortest possible lead. The lead from the mid-point of this screen strap to the variable capacitor and from the variable capacitor to ground should have as little inductance as possible.

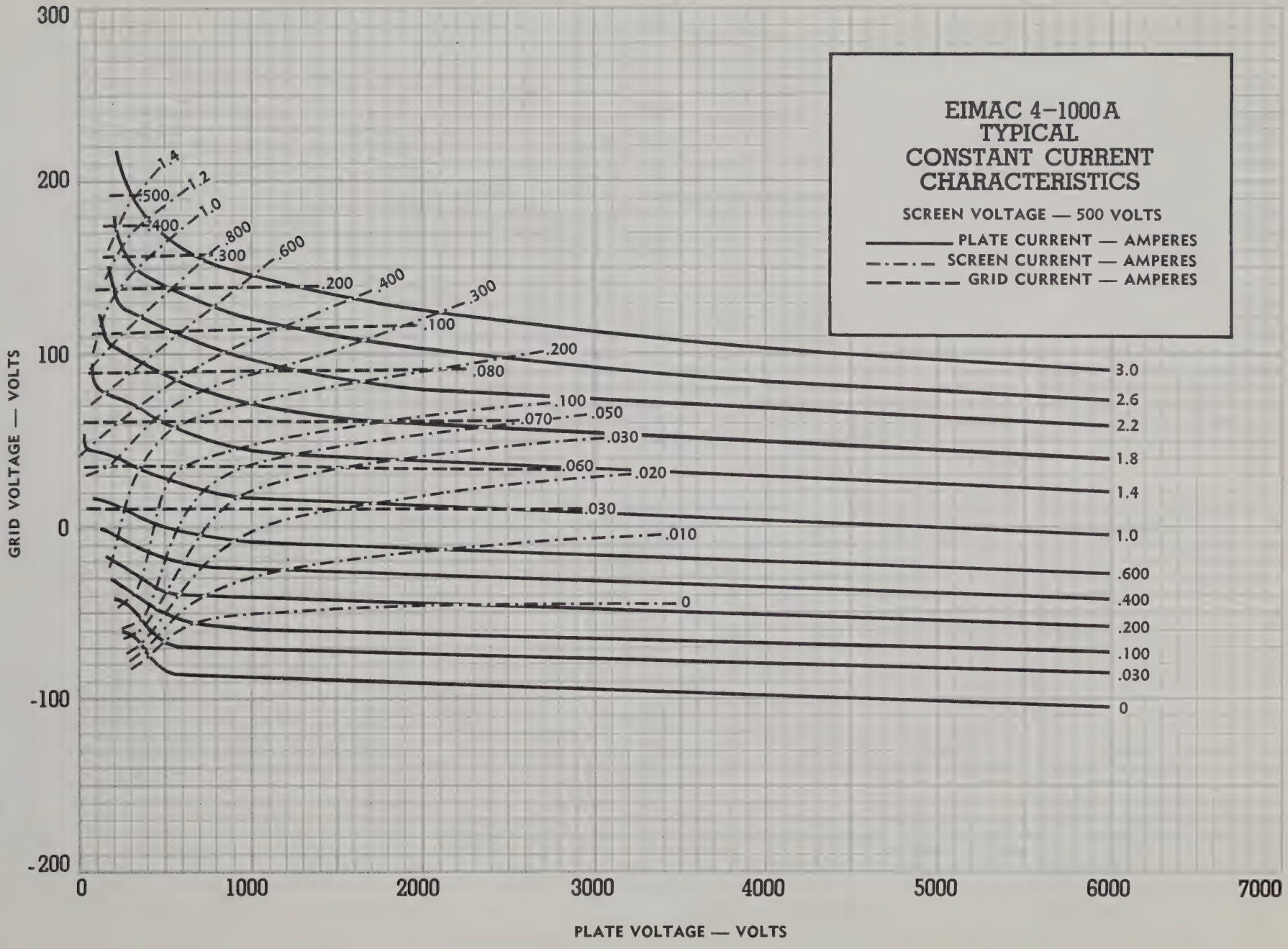
In general, plate, grid, filament, and screen-bypass or screen-neutralizing capacitors should be returned to r-f ground through the shortest possible leads.

In order to take full advantage of the high power gain obtainable with the 4-1000A, care should be taken to prevent feedback from the output to input circuits. A conventional method of obtaining the necessary shielding between the grid and plate circuits is to use a suitable metal chassis with the grid circuit mounted below the deck and the plate circuit mounted above the deck. Power-supply leads entering the amplifier should be bypassed to ground and properly shielded to avoid feedback coupling in these leads. The output circuit and antenna feeders should be arranged so as to preclude any possibility of feedback into other circuits.









Printed in U.S.A. 66410

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4-1000A

POWER TETRODE
•
MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 4-1000A is a beam power tetrode with a maximum plate dissipation rating of 1000 watts. Intended for use as an amplifier, oscillator, or modulator, the 4-1000A is capable of efficient operation well into the vhf range.

In FM broadcast service on 110 Mc., two 4-1000A tetrodes will deliver a useful power output over 5000 watts.

Operating under class AB_2 modulator conditions with less than 10 watts of peak driving power, two of these tubes will deliver 3900 watts of output power.

With zero watts driving power in class AB_1, a pair of 4-1000A tetrodes will deliver 3800 watts of power output.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified through the use of the Eimac 4-1000A Air-System Socket.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	7.5 volts
Current	21 amperes
Grid-Screen Amplification Factor (Average)	7
Direct Interelectrode Capacitances (Average)	
Grid-Plate (without shielding, base grounded)	0.24 $\mu\mu f$
Input	27.2 $\mu\mu f$
Output	7.6 $\mu\mu f$
Transconductance (i_b = 300 ma., E_b = 2500 v., E_{c2} = 500 v.)	10,000 umhos
Highest Frequency for Maximum Ratings	110 Mc

MECHANICAL

Base	5-pin metal shell (see dwg.)
Basing	See drawing
▶ Recommended Socket	Eimac 4-1000A Air-System Socket
Mounting position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat Dissipating Connector:	
Plate	Eimac HR-8
Maximum Over-all Dimensions:	
Length	9.63 inches
Diameter	5.25 inches
Net Weight (tube only)	1.5 pounds
Shipping Weight	12 pounds

If an Air-System Socket is used, mounted on a 1/4" deck, the over-all dimensions of the system including chimney and HR-8 cooler are

Length	11.75 inches
Diameter	7.5 inches

Note: Typical operation data are based on conditions of adjusting to a specified plate current, maintaining fixed conditions of grid bias, screen voltage and r-f grid voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR
Class AB

MAXIMUM RATINGS (PER TUBE)

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	700 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION
Class AB_1 (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	1000	1000	1000	volts
D-C Grid Voltage (approx.)*	—115	—125	—135	volts
Zero-Signal D-C Plate Current	300	240	200	ma
Max-Signal D-C Plate Current	1.05	1.00	.95	amp
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	60	60	64	ma
Effective Load, Plate-to-Plate	7000	10,000	14,000	ohms
Peak A-F Grid Input Voltage (per tube)	115	125	135	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	930	950	930	watts
Max-Signal Plate Power Output	2340	3100	3840	watts

*Adjust to give stated zero-signal plate current. The D-C resistance in series with the control grid of each tube should not exceed 250,000 ohms.

TYPICAL OPERATION
Class AB_2 (Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage (approx.)*	—60	—70	—75	volts
Zero-Signal D-C Plate Current	300	200	150	ma
Max-Signal D-C Plate Current	1.20	1.10	.95	amp
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	95	90	65	ma
Effective Load, Plate-to-Plate	7000	11,000	15,000	ohms
Peak A-F Grid Input Voltage (per tube)	140	145	130	volts
Max-Signal Peak Driving Power	11.0	11.0	9.4	watts
Max-Signal Nominal Driving Power (approx.)	5.5	5.5	4.7	watts
Max-Signal Plate Dissipation (per tube)	900	850	900	watts
Max-Signal Plate Power Output	3000	3800	3900	watts

*Adjust to give stated zero-signal plate current.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

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▶ Indicates changes from sheet dated 11-15-50.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR
Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS (Key-down conditions, per tube to 110 Mc.)

D-C PLATE VOLTAGE	6000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	700 MAX. MA
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

TYPICAL OPERATION (Frequencies below 110 Mc., one tube)

D-C Plate Voltage	3000	4000	5000	6000	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage	—150	—150	—200	—200	volts
D-C Plate Current	700	700	700	700	ma
D-C Screen Current	146	137	147	140	ma
D-C Grid Current	38	39	45	42	ma
Screen Dissipation	73	69	73	70	watts
Grid Dissipation	5	6	7	6	watts
Peak R-F Grid Input Voltage (approx.)	290	290	355	350	volts
Driving Power (approx.)*	11	12	16	15	watts
Plate Power Input	2100	2800	3500	4200	watts
Plate Dissipation	670	700	690	800	watts
Plate Power Output	1430	2100	2810	3400	watts

*Apparent driving power requirements increase above 30 Mc. At 110 Mc. the driver should be capable of supplying 200 watts per tube to take care of feed-through, circuit losses, and radiation.

TYPICAL OPERATION (110 Mc., two tubes, push-pull)

D-C Plate Voltage	4000	5000	6000	volts
D-C Screen Voltage	450	500	500	volts
D-C Grid Voltage	—150	—160	—180	volts
D-C Plate Current	1.15	1.25	1.25	amps
D-C Screen Current	280	240	250	ma
D-C Grid Current	80	80	100	ma
Screen Dissipation (per tube)	63	60	63	watts
Driving Power (approx.)	350	400	400	watts
Plate Power Input	4600	6250	7500	watts
Plate Dissipation (per tube)	650	850	900	watts
Useful Power Output	3000	4200	5200	watts

These 110 Mc. typical performance figures were obtained by direct measurement in operating equipment. The output power is useful power measured in a load circuit. The driving power is that taken by the tube and a practical resonant circuit. In many cases with further refinement and improved techinques, better performance might be obtained.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER
Class-C Telephony—Carrier Conditions

MAXIMUM RATINGS (Per tube to 110 Mc.)

D-C PLATE VOLTAGE	5000 MAX. VOLTS*
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	600 MAX. MA
PLATE DISSIPATION	670 MAX. WATTS
SCREEN DISSIPATION	75 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

*5500 Max. volts below 30 Mc.

TYPICAL OPERATION (Frequencies below 110 Mc., one tube)

D-C Plate Voltage	3000	4000	5000	5500*	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage	600	600	600	600	ma
D-C Plate Current	—200	—200	—200	—200	volts
D-C Screen Current	145	132	130	105	ma
D-C Grid Current	36	33	33	28	ma
Screen Dissipation	72	66	65	52	watts
Grid Dissipation	5	4	4	3	watts
Peak A. F. Screen Voltage (100% modulation)	250	250	250	250	volts
Peak R-F Grid Input Voltage	340	335	335	325	volts
Driving Power**	12	11	11	9	watts
Plate Power Input	1800	2400	3000	3300	watts
Plate Dissipation	410	490	560	670	watts
Plate Power Output	1390	1910	2440	2630	watts

*5500 volt operation may be used only below 30 Mc.
**Apparent driving power requirements increase above 30 Mc. At 110 Mc. the driver should be capable of supplying 200 watts per tube to take care of feed-through, circuit losses, and radiation.

Pulse Service—For information on Pulse Service Ratings, "Application Bulletin No. 3, Pulse Service Notes", will be furnished free on request.

APPLICATION

MECHANICAL

Mounting—The 4-1000A must be mounted vertically base up or base down. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube. The socket must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube base shell should be grounded by means of suitable spring fingers. A flexible connecting strap should be provided between the HR cooler on the plate terminal and the external plate circuit. The socket must not apply excessive lateral pressure against the base pins. The tube must be protected from severe vibration and shock.

Cooling—Adequate forced-air cooling must be provided to maintain the base seal temperatures below 150°C and the plate seal below 200°C. The problem of cooling is greatly simplified by using the Eimac 4-1000A Air-System Socket and its accompanying chimney. This system is designed to maintain the correct balance of cooling air for the various parts of the tube. The minimum quantity of air required by this system for maximum power output at 110 Mc. is 45 cfm at an inlet static pressure of approximately 1.2 inches of water.

In the event that an Air-System Socket is not used, provision must be made to circulate air through the base, around the envelope and over the plate seal. This is in addition to the normal cooling required by the base. Seal temperature limitations may require that cooling air be supplied to the tube even when filament alone is on during standby periods.

Tube temperatures may be measured with the aid of "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N. Y.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 7.5 volts. Unavoidable variations in filament voltage must be kept within the range from 7.13 to 7.87 volts.

Bias Voltage—The D-C bias voltage for the 4-1000A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In the case of operation above 50 Mc., it is advisable to keep the bias voltage as low as possible. (See "Operation".)

Screen Voltage—The D-C screen voltage for the 4-1000A should not exceed 1000 volts. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

Indicates changes from sheet dated 11-15-50.

Plate Voltage—The plate-supply voltage for the 4-1000A should not exceed 6000 volts in CW and audio applications. In plate-modulated telephony service above 30 Mc., the D-C plate-supply voltage should not exceed 5000 volts; however, below 30 Mc., 5500-volt operation may be used.

Grid Dissipation—Grid dissipation for the 4-1000A should not be allowed to exceed 25 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where: P_g = Grid dissipation,
e_{cmp} = Peak postive grid to cathode voltage, and
I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak volt-meter connected between filament and grid. (For suitable peak v.t.v.m. circuits, see for instance, "Vacuum Tube Ratings", Eimac News, January 1945. This article is available in reprint form on request.)

Screen Dissipation—The power dissipated by the screen of the 4-1000A must not exceed 75 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 75 watts in event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-1000A should not be allowed to exceed 1000 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 670 watts. The plate dissipation will rise to 1000 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

OPERATION

CLASS-C R-F AMPLIFIER

Neutralization—If reasonable precautions are taken to prevent coupling between input and output circuits, the 4-1000A may be operated up to the 10 Mc. region without neutralization. In the region between 10 Mc. and 30 Mc., the conventional type of cross-neutralizing may be used with push-pull circuits. In single-ended circuits ordinary neutralization systems may be used which provide 180° out of phase voltage to the grid. A simple and effective method of neutralizing single-ended tetrode circuits is described by Warren B. Bruene in "How to Neutralize Your Single-Ended Tetrode Final", in the August, 1950, issue of CQ magazine.

At frequencies above 30 Mc. the feedback is principally due to screen-lead-inductance effects. Feedback is eliminated by using series capacitance in the screen leads between the screen and ground. A variable capacitor of from 25 to 50 uufds will provide sufficient capacitance to neutralize each tube in the region of 100 Mc. When using this method, the two screen terminals on the socket should be strapped together by the shortest possible lead. The lead from the mid-point of this screen strap to the variable capacitor and from the variable capacitor to ground should be made with as low inductance as possible.

In general, plate, grid, filament and screen bypass or screen neutralizing capacitors should be returned to r-f ground through the shortest possible leads.

In order to take full advantage of the high power gain obtainable with the 4-1000A, care should be taken to prevent feedback from the output to input circuits. A conventional method of obtaining the necessary shielding beween the grid and plate circuits is to use a suitable metal chassis with the grid circuit mounted below the deck and the plate circuit mounted above the deck. Power supply leads entering the amplifier should be bypassed to ground and properly shielded to avoid feedback coupling in these leads. The output circuit and antenna feeders should be arranged so as to preclude any possibility of feedback into other circuits.

VHF Circuits—A typical linear tank circuit for use with the 4-1000A in the 110 Mc. region consists of a "quarter wavelength" plate tank and a "half wavelength" grid tank circuit. Precautions must be observed in the placement of components to avoid the possibility of accidentally creating higher frequency tank circuits than the desired one. This could occur if a tuning capacitor were placed in a position on the line where it would create a resonant circuit at or near a harmonic frequency. A properly neutralized amplifier at the fundamental frequency would appear regenerative at higher parasitic frequencies and instability or oscillation would result.

Any capacitance tuning in the plate line should be kept to a small value, acting as a trimmer for the shorting-bar tuning. Such a variable capacitor should be positioned on the plate line as close as possible to the plate leads. The tuning capacitor on the "half wave" grid line should be positioned at the extreme end of the line away from the tube.

In many cases where parasitic oscillation or regenerative harmonic amplification occurs, it is not evident until grid excitation at the fundamental frequency is applied. If the amplifier tunes in a normal manner and the efficiency appears normal for the frequency of operation, it may be assumed that the amplifier is free of parasitic oscillation and harmonic regeneration.

VHF Operation—Above 50 Mc., electron transit time factors in the tube become important, increasing in degree as the frequency is increased. When the grid swings highly negative in potential, electrons, "trapped" enroute by the rapidly changing r-f voltage, can be deflected from their normal paths. If excessively large r-f plate voltages exist due to light plate loading, these electrons are rejected at high velocity to bombard tube parts normally outside the electron stream. This effect occurs when an amplifier goes into parasitic oscillation, as there is practically no loading in the plate circuit and the excitation is almost always extremely high. Bombardment can cause premature tube failure by a focusing of stray electrons on metal parts or the glass envelope of a tube. Such concentration of a stray electron stream will usually overheat the material at the point of focus, with the probability of gas evolvement that can lead to loss of filament emission or destruction of the tube. Where glass is the overheated material, a small hole or "suck-in" can occur, opening the tube to atmosphere. Dependent upon the degree of bombardment, tube failures can occur in a matter of minutes, or after a few thousand hours of life. Either way, the full life potential is not realized.

In order to minimize stray bombardment, the following rules should be followed in vhf operation of straight through amplifiers.

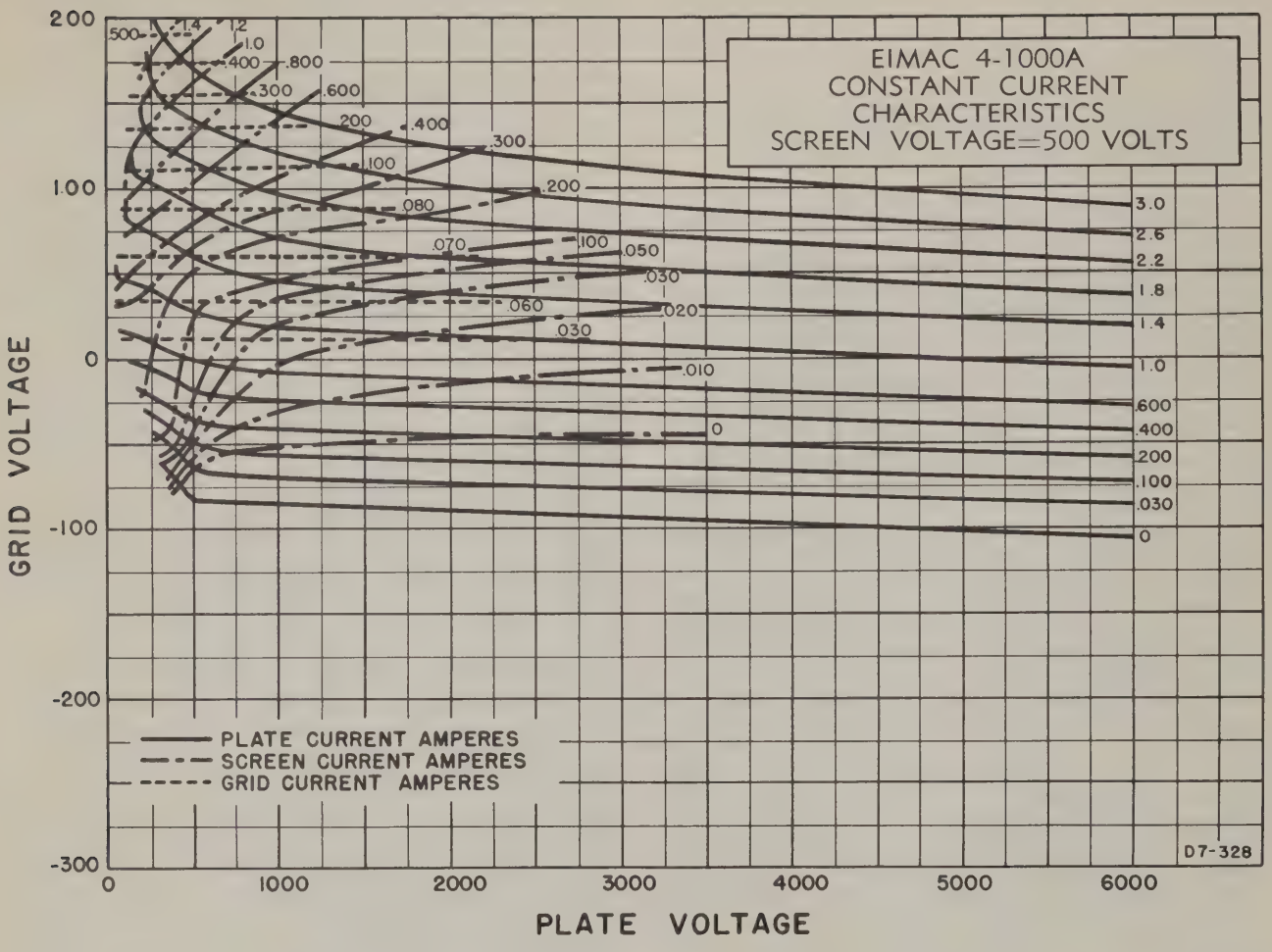
1. Use a minimum amount of bias (not over 1.5 to 2.0 times cut-off).

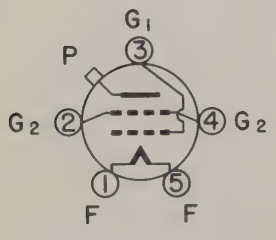
2. Use only enough drive to obtain satisfactory operation and good plate efficiency.

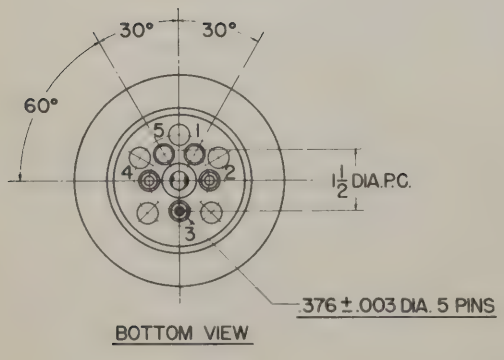
3. Use fairly heavy plate loading. Low plate voltage and high plate current is better than high plate voltage and low plate current. Avoid operating the stage unloaded or lightly loaded. If conditions are such that the stage must be operated lightly-loaded, then the driving power should be reduced proportionately. Install under-current protection, especially where unloaded operation can occur due to antenna failures or transmission line icing.

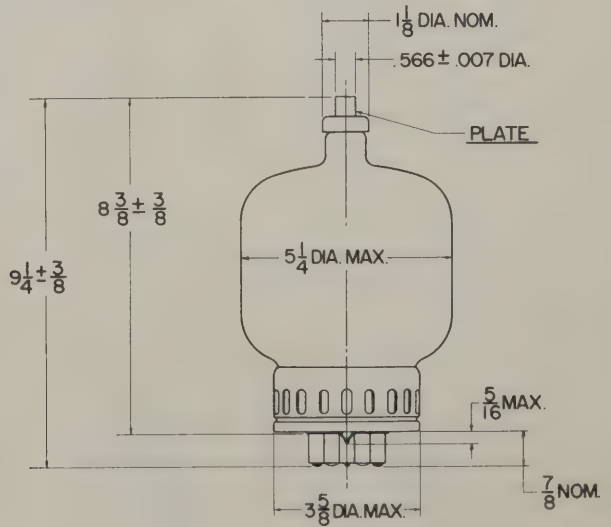
4. Operate the screen grid at a reasonably high voltage, still keeping within screen dissipation ratings.

▶ Indicates changes from sheet dated 11-15-50.


EIMAC 4-1000A
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE=500 VOLTS
GRID VOLTAGE
PLATE VOLTAGE
PLATE CURRENT AMPERES
SCREEN CURRENT AMPERES
GRID CURRENT AMPERES
D7-328
200
100
0
-100
-200
-300
0
1000
2000
3000
4000
5000
6000
500
1.4
1.2
1.0
.800
.600
.400
.300
.200
.100
.080
.070
.060
.050
.030
.020
.010
0
3.0
2.6
2.2
1.8
1.4
1.0
.600
.400
.200
.100
.030
0


G1
P
G2
G2
F
F


30°
30°
60°
1½ DIA. P.C.
.376 ± .003 DIA. 5 PINS
BOTTOM VIEW


1⅛ DIA. NOM.
.566 ± .007 DIA.
PLATE
8⅜ ± ⅜
9¼ ± ⅜
5¼ DIA. MAX.
5/16 MAX.
7/8 NOM.
3⅝ DIA. MAX.

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4-1000A

AIR-SYSTEM SOCKET



In order to simplify the cooling problem of the Eimac 4-1000A tetrode and assure adequate air-flow to the various seals, the Eimac Air-System Socket was developed. This system is so designed that the correct amount of cooling air is distributed to the various seals in the right proportion.

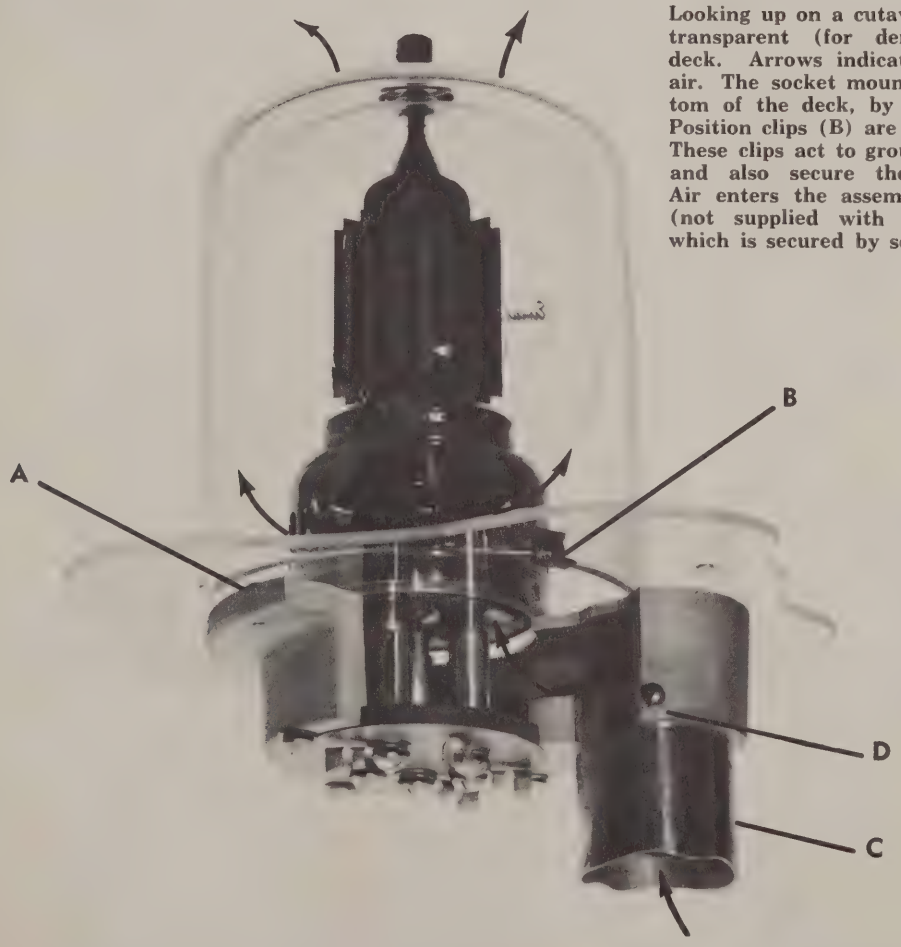
The Air-System Socket includes a socket to support the 4-1000A tetrode and to make the necessary base connections, and a complete air cooling system. The air enters the bottom of the socket through a 2-inch duct, cools the base terminals, flows through the base of the tube, is guided by the socket chimney past the glass envelope, and is directed against the heat dissipating connector at the plate terminal. A minimum quantity of air is thereby used effectively to cool the tube adequately under the severest requirements of the tube's ratings.

A flow of 45 CFM of air is required at an inlet static pressure of approximately 1.2" of water. The blower must be capable of supplying these requirements and also whatever added pressure drop is introduced by the connecting ducts and air filters.

These air figures are based on sea-level operation with an ambient temperature of 25°C, and for amplifier operation at 110 Mc. where the r-f charging current into the plate-screen capacitance is most severe. Cooling with this air flow will keep all base seals below the maximum allowable temperature limit of 150°C and the plate seal below the allowable limit of 200°C. Proper flow of air can be indicated by measuring the pressure existing in the cast socket. A 1/4" hole, tapped with 28 threads per inch, is provided to make connection to a water manometer. The static pressure at this point is 1.2" of water when 45 CFM is flowing. The manometer tube probe should be flush with the inside surface of the socket manifold. The hole in the probe should be made with a No. 31 drill.

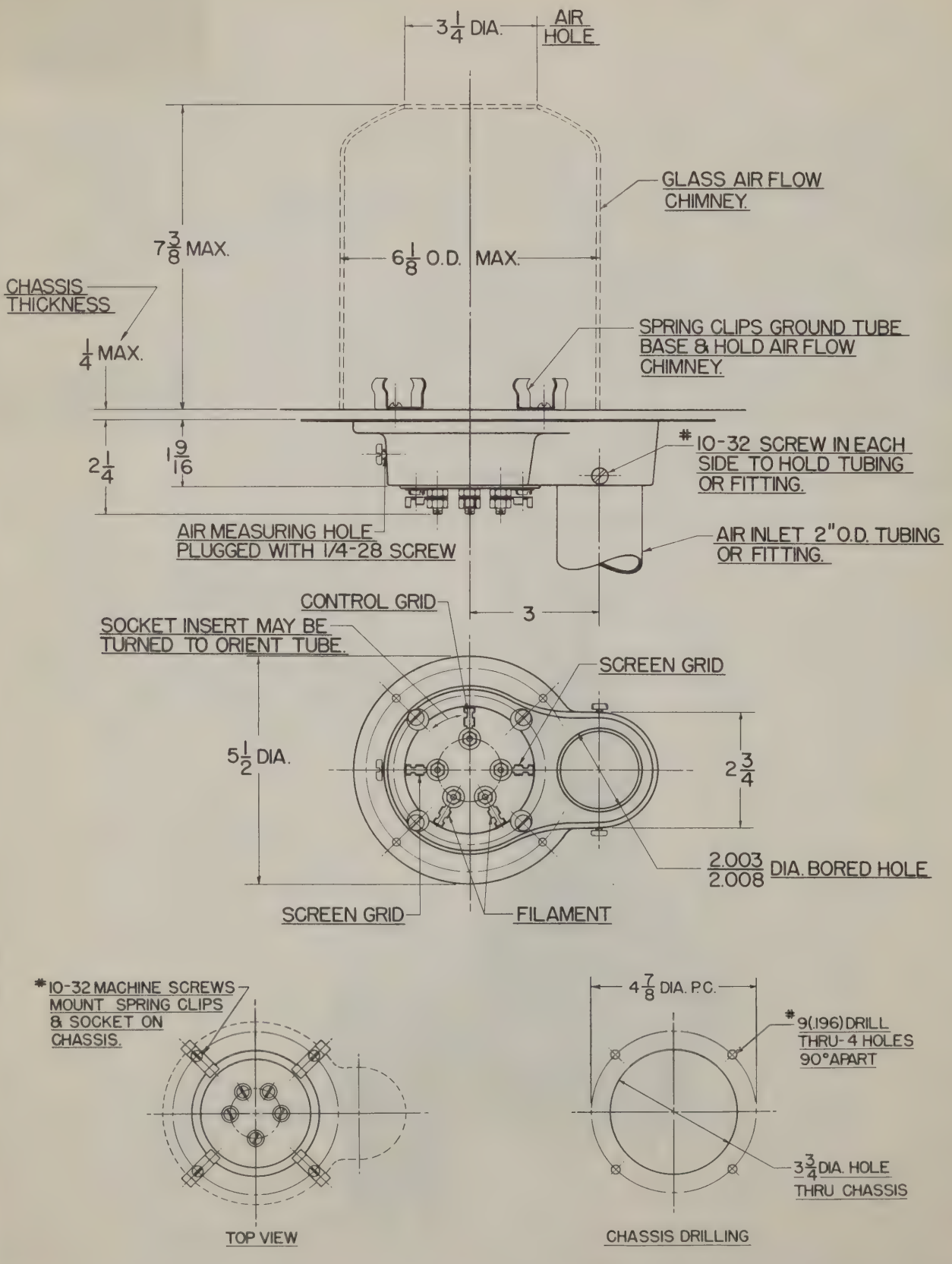
Where operation is below 30 Mc., an air flow of at least 30 CFM is adequate. This corresponds to an inlet pressure at the 4-1000A socket of 0.3" of water.

In making electrical connections to the socket terminals, flexible leads should be used to preserve the freedom of motion of the connector jacks of the socket. A screw driver slot has been provided inside the jacks to hold the jacks while tightening the nuts on the underside of the socket. The first nut seats on a shoulder to prevent clamping the jack to the insulating material. The second nut should be used to secure the connector terminal lugs.



Looking up on a cutaway socket mounted on transparent (for demonstration purposes) deck. Arrows indicate the flow of cooling air. The socket mounts, flush with the bottom of the deck, by means of screws (A). Position clips (B) are on the top of the deck. These clips act to ground the tube base shell and also secure the air-system chimney. Air enters the assembly through duct (C), (not supplied with the socket assembly) which is secured by set-screw (D).

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Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

TENTATIVE DATA

4CX300A

CERAMIC POWER TETRODE



The Eimac 4CX300A is a compact integral-finned external-anode power tetrode having a maximum plate-dissipation rating of 300 watts. The 4CX300A may be operated at frequencies up to 500 megacycles.

The all-ceramic-and-metal construction and the internally-unitized electrode structure combine to make the 4CX300A especially durable and free from mechanically-induced noise under conditions of severe acceleration caused by shock or vibration.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage (See "Application")		6.0		volts
Current (E_f=6.0 volts)	2.5		3.2	amperes
Amplification Factor (Grid to Screen)	4.0	4.8	5.6	
Transconductance (I_b=200 ma.)		12,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	25	29	33	uuf
Output	3.5	4.0	5.5	uuf
Feedback			0.06	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Min.	Nom.	Max.	
Input	-	16.2		uuf
Output	3.5	4.0	5.5	uuf
Feedback	-	0.01		uuf
Frequency for Maximum Ratings	-	-	500	mc

MECHANICAL

Base	Special, breech-block terminal surfaces
Recommended Socket	Eimac SK-700 Series
Operating Position	Any
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	- 250° C
Anode Core	- 250° C
Cooling	Forced Air
Maximum Over-All Dimensions:	
▶ Height	2.5 inches
Diameter	1.65 inches
Net Weight	3.75 ounces
Shipping Weight (Approximate)	1.5 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	500	1000	1500	2000	2500***	2000	volts
D-C Screen Voltage	250	250	250	250	250	250	volts
D-C Grid Voltage	—90	—90	—90	—90	—90	—90	volts
D-C Plate Current	250	250	250	250	250	250	ma
D-C Screen Current*	45	38	21	19	16	10**	ma
D-C Grid Current*	35	31	28	26	25	25**	ma
Peak R-F Grid Voltage*	114	114	112	112	111	—	volts
Driving Power*	4.0	3.5	3.2	2.9	2.8	—	watts
Plate Input Power	125	250	375	500	625	500	watts
Plate Output Power	70	190	280	390	500	225**	watts
Heater Voltage						5.5	volts

*Approximate values.
**Measured values for a typical cavity amplifier circuit at 500 Mc.
***For operation below 250Mc. only.

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▶ Indicates change from sheet dated 12-24-57

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

▶ TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000	2500**	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	200	200	200	200	ma
Max-Signal D-C Plate Current	500	500	500	500	ma
Max-Signal D-C Screen Current	20	16	10	8	ma
Effective Load, Plate to Plate	3500	6200	9500	11,600	ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50	50	volts
Driving Power	0	0	0	0	watts
Max-Signal Plate Output Power	240	430	600	800	watts

*Approximate values.
**For operation below 250 megacycles only.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

▶ TYPICAL OPERATION

D-C Plate Voltage	1000	1500	2000	2500**	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	100	100	100	100	ma
D-C Plate Current	150	150	150	150	ma
D-C Screen Current*	—3	—4	—4	—4	ma
Peak R-F Grid Voltage*	25	25	25	25	volts
Plate Output Power	30	50	65	85	watts

*Approximate values.
**For operation below 250 megacycles only.
[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

▶ TYPICAL OPERATION (Peak-envelope conditions except where noted)

D-C Plate Voltage	1000	1500	2000	2500**	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	100	100	100	100	ma
Peak R-F Grid Voltage*	50	50	50	50	volts
D-C Plate Current	250	250	250	250	ma
D-C Screen Current*	10	8	5	4	ma
Plate Input Power	250	375	500	625	watts
Plate Output Power	120	215	300	400	watts
Two-Tone Average D-C Plate Current	190	190	190	190	ma
Two-Tone Average D-C Screen Current*	2	—1	—2	—2	ma

*Approximate values.
**For operation below 250 megacycles only.
[1]Adjust grid bias to obtain listed zero-signal plate current.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	200 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	500	1000	1500	volts
D-C Screen Voltage	250	250	250	volts
D-C Grid Voltage	—100	—100	—100	volts
D-C Plate Current	200	200	200	ma
D-C Screen Current*	31	22	20	ma
D-C Grid Current*	15	14	14	ma
Peak R-F Grid Input Voltage*	118	117	117	volts
Driving Power*	1.8	1.7	1.7	watts
Plate Input Power	100	200	300	watts
Plate Output Power	60	145	235	watts

*Approximate values.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. The driving power and power output shown are substantially correct at frequencies below 175 Mc. Allowance must be made for grid and plate circuit losses. At frequencies above 175 Mc. additional allowance must be made for high-frequency effects within the tube itself. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

▶ Indicates change from sheet dated 12-24-57

APPLICATION

MECHANICAL

Mounting—The 4CX300A may be operated in any position. Recommended sockets for the 4CX300A are the Eimac Air-System Sockets type SK-700 (ungrounded cathode) or type SK-710 (cathode and one heater grounded). Both sockets provide connections to all electrodes except the plate and each includes a screen by-pass capacitor of 1100$\mu\mu$f in its structure. The breech-block terminal arrangement provides firm mechanical retention of the tube when subjected to shock or vibration.

Cooling—The maximum rated surface temperature for any part of the 4CX300A is 250° C. Adequate forced-air cooling facilities must be provided to assure that this maximum temperature rating is not exceeded. At sea level with an ambient temperature of 20° C adequate cooling for 300 watts plate dissipation can be obtained with an air-flow rate of 6.8 CFM, corresponding to a pressure drop of 0.4 inches of water column across an SK-700 or SK-710 socket and the cooling-fin assembly of the tube. (Air-flow rate in CFM is approximately eleven times the square root of the pressure differential across tube and socket.)

At high altitudes and high ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using the maximum rated temperature as the criterion for satisfactory cooling.

Cooling effectiveness should also be determined on an individual basis if the 4CX300A is operated immersed in an insulating fluid such as silicone oil, again using the maximum rated temperature as the criterion.

▶ **Impact and Vibration**—The 4CX300A is designed to operate under impact or vibration capable of disabling a conventional tube of similar power capabilities. Impact forces up to 50g with 11-millisecond duration time, or vibratory accelerations up to 20g at frequencies from 20 to 2000 cycles per second, will not destroy a normal 4CX300A unless unduly prolonged.

It is not suggested that the 4CX300A be subjected to abusive treatment unnecessarily, but in applications where operation under severe environmental conditions is unavoidable the 4CX300A will provide more reliable service than will conventional tubes.

ELECTRICAL

Heater Operation—The rated heater voltage for the 4CX300A is 6.0 volts. At frequencies higher than 300 megacycles the heater voltage should be reduced according to the following schedule:

Frequency (Mc.)	Heater Voltage (Volts)
Up to 300	6.00
300 to 400	5.75
400 to 500	5.50

The heater voltage must be maintained within ± 5% of the selected operating voltage if variations in circuit performance are to be minimized and best tube life obtained.

Cathode Operation—The 4CX300A employs a cylindrical indirectly-heated oxide-coated unipotential cathode. The minimum warm-up time is 30 seconds when rated heater voltage is applied.

Grid Operation—The 4CX300A control grid has a maximum dissipation rating of 2.0 watts, and precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the Typical Operation sections of the data sheet whenever possible.

At frequencies higher than 300 Mc., the driving power required by the circuits associated with the tube begins to increase, until at 500 Mc., as much as 30 watts of driving power may be required. The power dissipated by the control grid increases only slightly, however, in spite of the greatly increased driving power required by the circuit. Satisfactory 500-megacycle operation of the 4CX300A in a stable, "straight-through" amplifier is indicated by grid-current values below approximately 25 milliamperes.

In class-A and class-AB_1 amplifiers, where no grid current flows, the grid bias voltage may be applied through a resistor. The maximum permissible series resistance per tube is 100,000 ohms.

Screen Operation—The maximum rated screen dissipation for the 4CX300A is 12 watts. The maximum rated d-c screen supply voltage is 300 volts when the tube is operated in class-C amplifier or oscillator service, and 400 volts when the tube is operated in class-AB or class-B amplifier service.

Under certain operating conditions the screen current of a tetrode may reverse. This makes it dangerous to rely on a screen-dropping resistor or a series regulator to supply the screen voltage unless a bleeder or regulator tube is connected from screen to cathode. This bleeder should draw at least 15 milliamperes for each tube connected to the screen supply.

The power input to the screen can be calculated from the voltage and current whenever the screen-to-cathode potential does not vary. Screen modulation or cathode driving of tetrode amplifiers can lead to errors in measurement of screen input when the effective voltage and current exceed the indicated d-c values. When there is reason to suspect that the screen input exceeds the indicated power, it is advisable to maintain the indicated screen power input below approximately 75% of the rated screen dissipation.

An 1100-$\mu\mu$f screen by-pass capacitance is incorporated in the body of the recommended Eimac Air-System Sockets for the 4CX300A, adequate for normal amplifier operation at high and ultra-high radio frequencies. Operation at low radio frequencies or audio frequencies may require additional capacitance to be

▶ Indicates change from sheet dated 12-24-57

connected externally. In the latter case, the screen bypass capacitance within the socket helps to eliminate the high-frequency parasitic oscillations occasionally encountered in tetrode amplifiers.

The self-neutralizing frequency of the 4CX300A is above the useful high-frequency limit for the tube when either of the recommended sockets is used.

Plate Operation—The 4CX300A has a finned external anode for forced-air cooling. Connection to the anode may be made at the top cap or cylindrical cooler shell. The latter is usually used when the tube is installed in coaxial lines or cavities.

The absolute maximum plate-dissipation rating for the 4CX300A is 300 watts, which is also the rated maximum dissipation for class-C amplifier or oscillator applications and for class-B or class-AB amplifier applications. When the 4CX300A is used in plate-modulated amplifier applications, the plate-dissipation rating is 200 watts under carrier conditions, rising to 300 watts under 100% sine-wave modulation. Plate dissipation may be permitted to exceed the maximum rated value for brief periods, such as may occur while tuning.

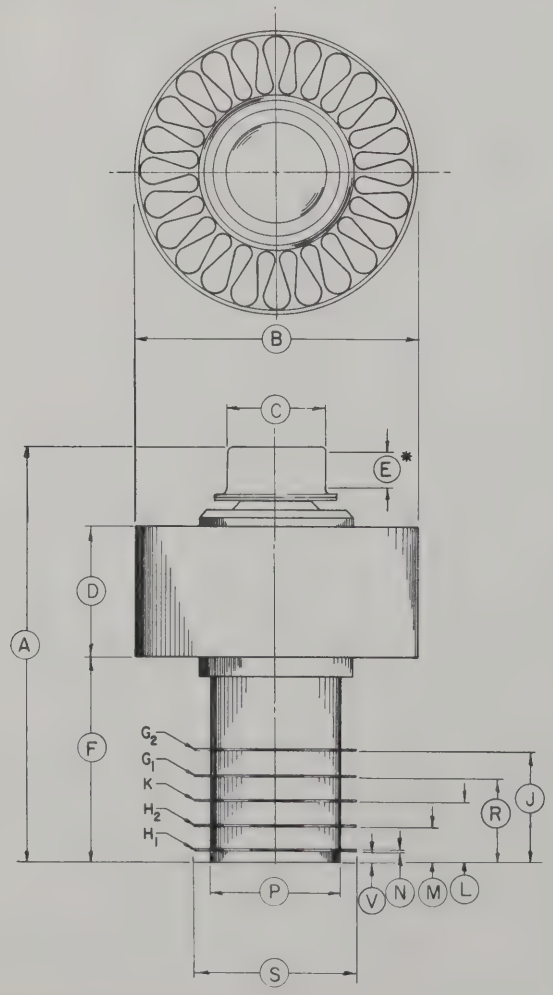
The maximum rated plate voltage for frequencies up to 500 megacycles is 2000 volts for all except plate-modulated-amplifier applications, for which the rated maximum is 1500 volts. At frequencies below 250 megacycles, a plate supply voltage of 2500 volts may be employed in all except class-C plate-modulated applications.

Modulation—The 4CX300A can be modulated by any of the methods commonly used with tetrode tubes. Its large reserve plate dissipation makes it especially suited for use in screen-modulated and linear amplifiers in which the plate efficiency is low.

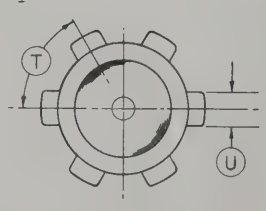
Plate modulation can be appplied to the 4CX300A when it is operated as a class-C amplifier. To obtain 100% modulation with minimum distortion the screen supply voltage should be modulated in phase with the modulation applied to the plate supply voltage. Screen voltage modulation factors between 0.75 and 1.00 may be used.

"Self-modulation" of the screen by means of a resistor in series with the screen supply line is not recommended because of the effects which require a bleeder from screen to cathode as described under "Screen Operation" above.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Eitel-McCullough, Inc. for information and recommendations.

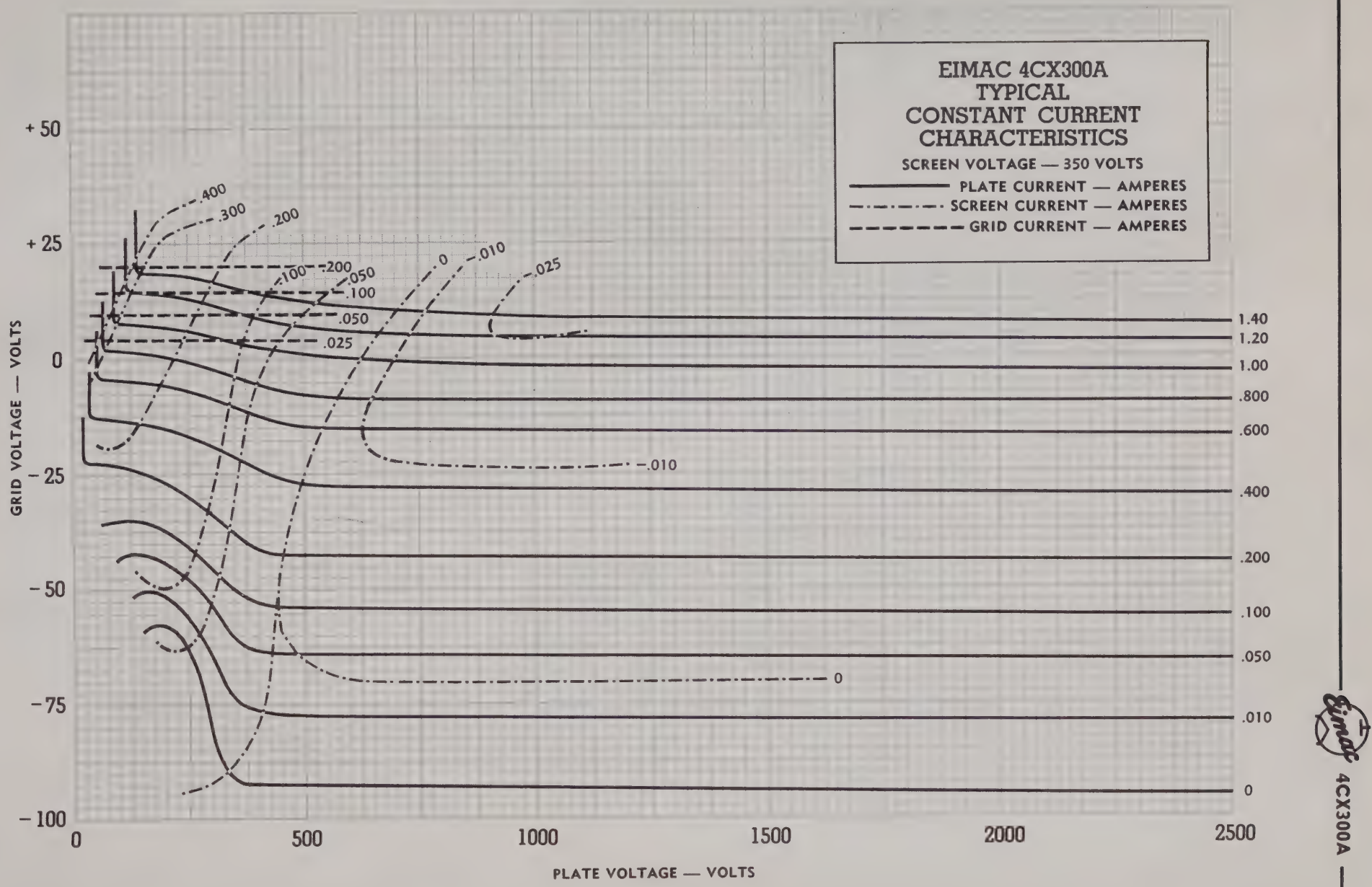


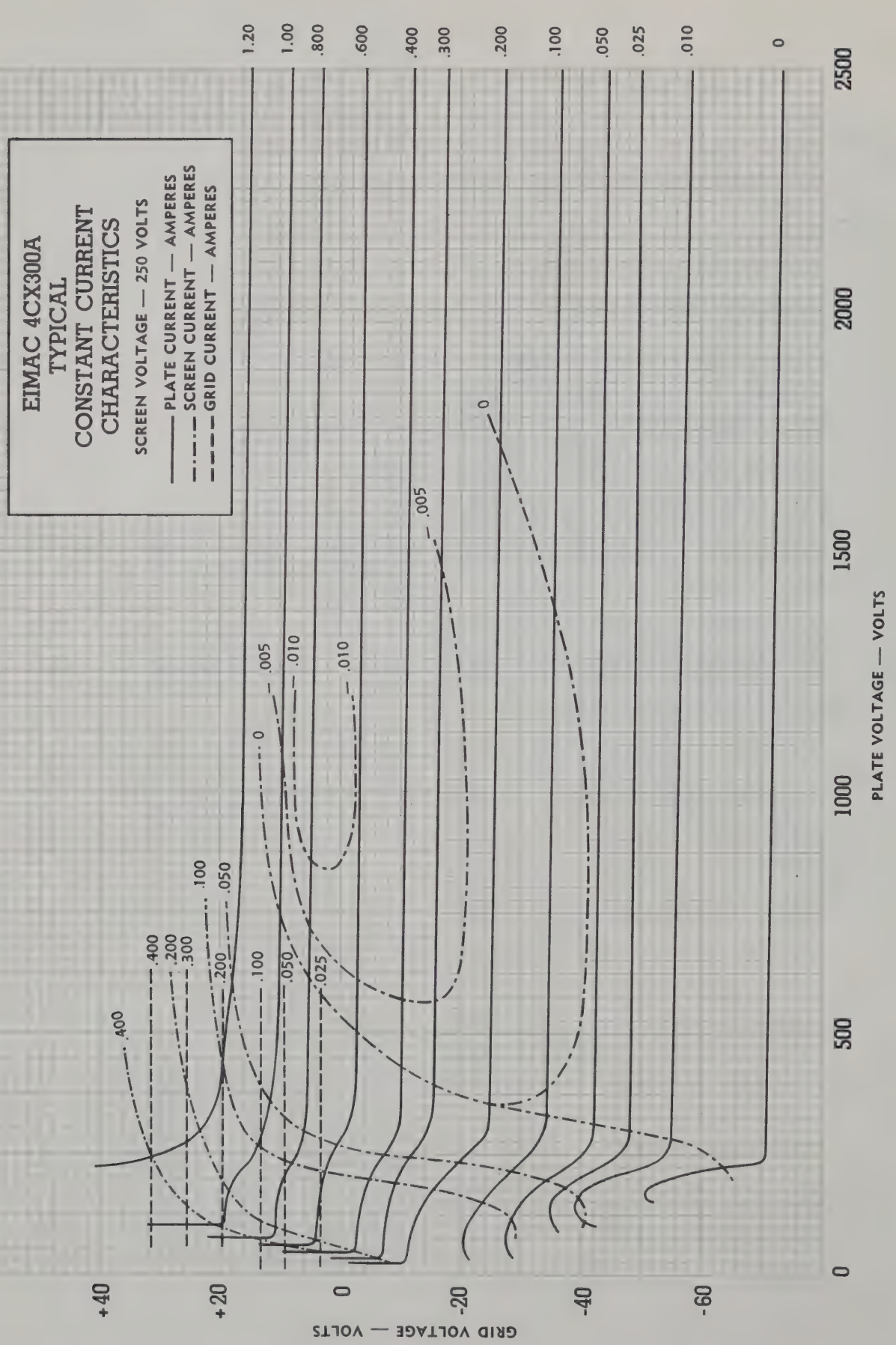
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A	2.400	2.300	2.500
B	1.625 DIA.	1.610 DIA.	1.640 DIA.
C	.566 DIA.	.559 DIA.	.573 DIA.
D	.750	.710	.790
E		.240	.280
F	1.164	1.133	1.195
J	.622	.602	.642
L	.344	.329	.359
M	.203	.193	.213
N	.0125 (TYP.)	.010 (TYP.)	.015 (TYP.)
P	.750 DIA.	.740 DIA.	.770 DIA.
R	.485	.470	.500
S	.946 DIA.	.936 DIA.	.956 DIA.
T	60°		
U	.175	.170	.185
V	.061	.050	.072



*CONTACT SURFACE

▶ Indicates change from sheet dated 12-24-57


EIMAC 4CX300A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 350 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
+ 50
+ 25
0
– 25
– 50
– 75
– 100
GRID VOLTAGE — VOLTS
0
500
1000
1500
2000
2500
PLATE VOLTAGE — VOLTS
.400
.300
.200
-.100
-.200
.050
.100
.050
.025
0
.010
.025
-.010
0
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0



Printed in U.S.A. 52467

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4X500A

RADIAL-BEAM POWER TETRODE



The Eimac 4X500A is an external-anode tetrode having a maximum plate dissipation rating of 500 watts. Its small size and low-inductance leads permit efficient operation at relatively large outputs well into the VHF region. The screen grid is mounted on a disc which terminates in a connector ring located between grid and plate, thus making possible effective shielding between the grid and plate circuits. The grid terminal is located at the center of the glass base to facilitate single-tube operation in coaxial circuits.

The combination of low grid-plate capacitance, low screen-lead inductance and functionally located terminals contributes to the stable operation of the 4X500A at high frequencies, making neutralization unnecessary in most cases and greatly simplifying it in others.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	volts
Current	13.5	amperes
Screen Grid Amplification Factor (Average)	6.2	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	0.05	$\mu\mu$fd
Input	12.8	$\mu\mu$fd
Output	5.6	$\mu\mu$fd
Transconductance (i_b=200 ma., e_b=2500 v., E_{c2}=500 v.)	5200	μmhos
▶ Frequency for Maximum Ratings	120	Mc.

▶ MECHANICAL

Maximum Overall Dimensions:		
Length	4.75	inches
Diameter	2.625	inches
Net Weight	1.17	pounds
Shipping Weight (Average)	6	pounds
Mounting Position	Vertical, base down or up	
Cooling	Forced Air	

At 500 watts plate dissipation, a minimum air-flow of 40 cubic feet per minute must be passed through the anode cooler. The pressure drop across the cooler at this rate of flow equals 1.4 inches of water. Forced-air cooling must be provided for the base and screen seals. Normally, suitable amounts of air may be obtained from a small centrifugal blower directed at the seals. In no case should the temperature of the metal-to-glass seals or the core of the anode cooler exceed 150°C. Cooling air specified above must be applied to the seals and the anode cooler prior to the application of filament power and continued for three minutes after power is removed from the filament.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C FM or Telegraphy (Key-down conditions, 1 tube)

MAXIMUM RATINGS (Frequencies up to 120 Mc.)

D-C PLATE VOLTAGE	4000 MAX.	VOLTS
D-C SCREEN VOLTAGE	500 MAX.	VOLTS
D-C GRID VOLTAGE	—500 MAX.	VOLTS
D-C PLATE CURRENT	350 MAX.	MA.
PLATE DISSIPATION	500 MAX.	WATTS
SCREEN DISSIPATION	30 MAX.	WATTS
GRID DISSIPATION	10 MAX.	WATTS

▶ TYPICAL OPERATION (Per tube, at 110 Mc.)

D-C Plate Voltage	2500	3000	4000	Volts
D-C Plate Current	310	310	315	Ma.
D-C Screen Voltage	500	500	500	Volts
D-C Screen Current	26	24	22	Ma.
D-C Grid Voltage	—150	—150	—150	Volts
D-C Grid Current	15	16	16	Ma.
Driving Power (approx.)	5	5	5	Watts
Useful Power Output (approx.)	475	600	835	Watts

▶ RADIO FREQUENCY POWER AMPLIFIER

Class-B Linear Amplifier, Television Visual Service

MAXIMUM RATINGS FOR TV (Frequencies up to 220 Mc.)

D-C PLATE VOLTAGE	3000 MAX.	VOLTS
D-C PLATE CURRENT	350 MAX.	MA.
D-C SCREEN VOLTAGE	500 MAX.	VOLTS
PLATE DISSIPATION	500 MAX.	WATTS
SCREEN DISSIPATION	30 MAX.	WATTS
GRID DISSIPATION	10 MAX.	WATTS

TYPICAL OPERATION

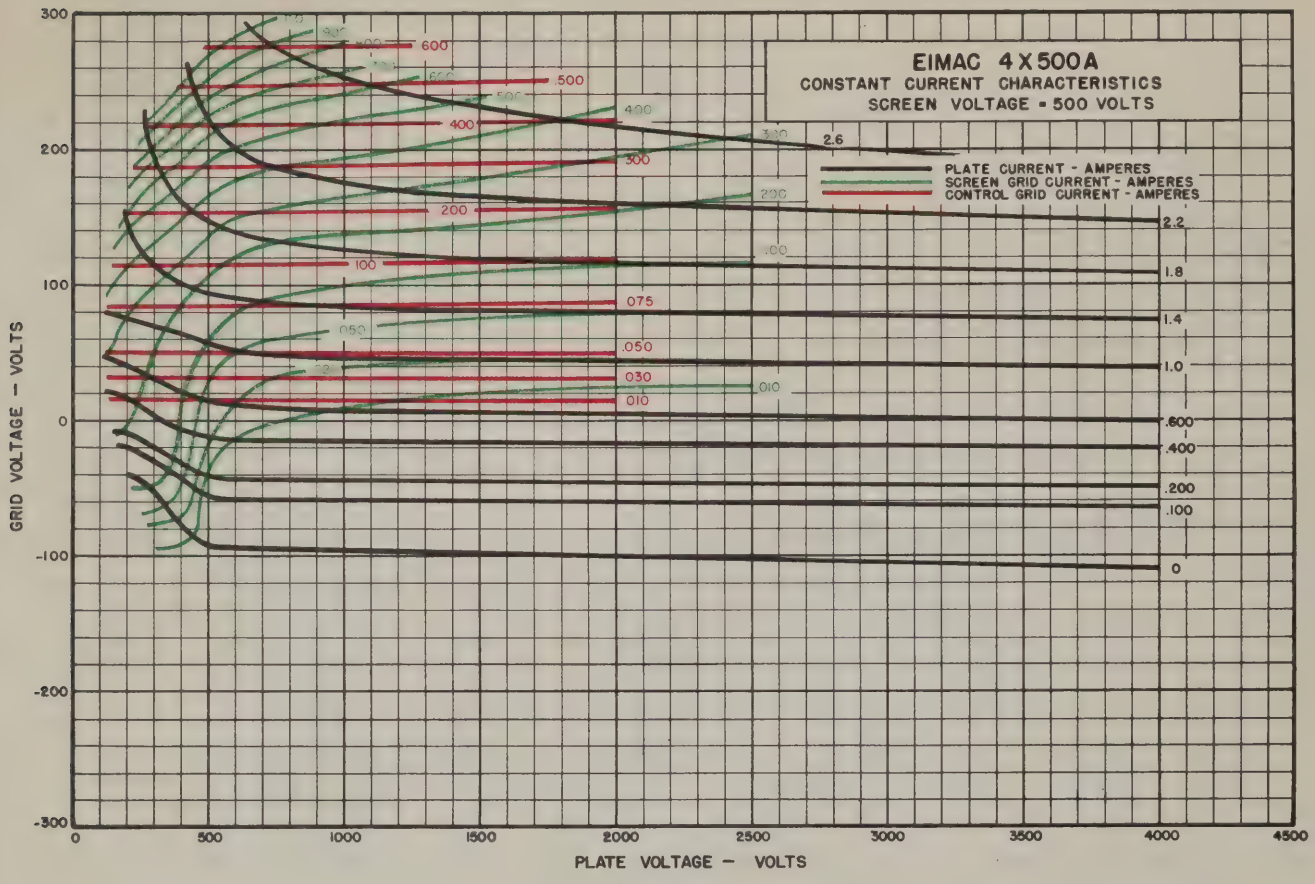
(Per tube at peak synchronizing level, 5-Mc. bandwidth, assumed load resistance 3,000 ohms per tube.)[1]

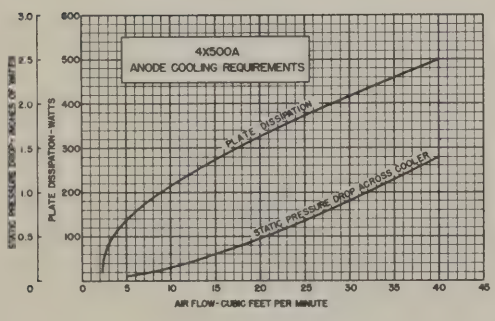
D-C Plate Voltage	1850	2400	Volts
D-C Screen Voltage	500	500	Volts
D-C Grid Voltage	—100	—100	Volts
D-C Plate Current	285	400[1]	Ma.
D-C Screen Current (approx.)	20	35	Ma.
D-C Grid Current (approx.)	10	15	Ma.
Peak R-F Grid Voltage	140	185	Volts
Driving Power, 220 Mc. (approx.)	15	25	Watts
Plate Power Input	525	960	Watts
Power Output	300	600	Watts
BLACK LEVEL			
D-C Plate Current	215	300	Ma.
D-C Screen Current	2	3	Ma.
D-C Grid Current	2	5	Ma.
Plate Power Input	400	720	Watts
Plate Dissipation	230	380	Watts
Power Output	170	340	Watts

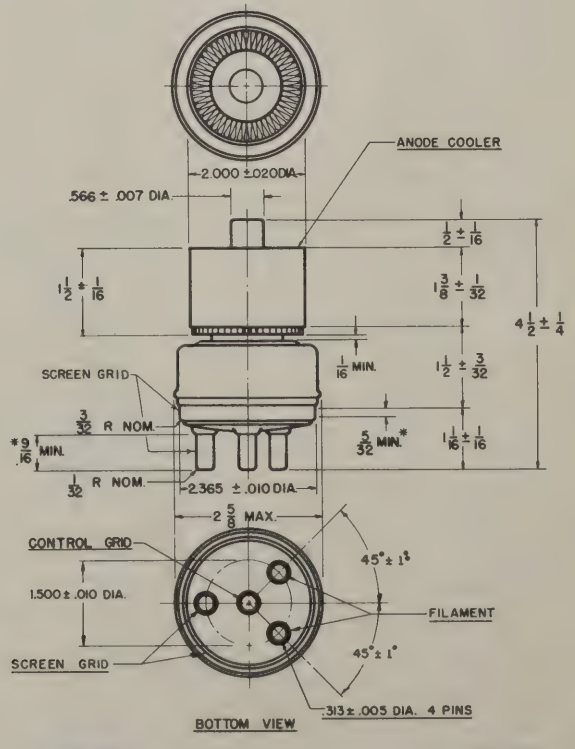
[1] Operating conditions at peak synchronizing level may be permitted fo exceed maximum ratings of the tube because of the low duty factor. Maximum ratings apply to black level conditions.

▶ Indicates change from sheet dated 11-15-46

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DIMENSIONS IN INCHES

* STRAIGHT SIDE AVAILABLE FOR CONTACT

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Printed in U. S. A. 2-J6-71702

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

TENTATIVE DATA

4CX250K
4CX250M

RADIAL-BEAM POWER TETRODES



The Eimac 4CX250K and 4CX250M are compact radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input power rating of 500 watts. The 4CX250K and 4CX250M are of ceramic and metal construction and are recommended for use in equipments of new design. The tubes have identical ratings and characteristics except for heater voltages and currents.

GENERAL CHARACTERISTICS

ELECTRICAL

		Min.	Nom.	Max.	
Cathode:	Oxide-coated, Unipotential				
	Heating Time	30	60		seconds
	Cathode-to-heater Potential			±150	volts
Heater:	Voltage: 4CX250K		6.0		volts
	4CX250M		26.5		volts
	Current: 4CX250K	2.30		3.0	amperes
	4CX250M	0.53		0.68	amperes
Amplification Factor (Grid-Screen)		4.4		6.0	
Transconductance (Ib=200Ma)			12,000		umhos
Frequency for Maximum Ratings				500	mc

Interelectrode Capacitances, Grounded Cathode:	Min.	Max.	
Input	25.0	29.0	uuf
Output	4.0	4.9	uuf
Feedback	–	0.05	uuf
Interelectrode Capacitances, Grounded Grid and Screen:			
Input	14.5	19.0	uuf
Output	4.0	4.9	uuf
Feedback	–	0.01	uuf

MECHANICAL

Base	Coaxial
Maximum Operating Temperatures:	
Anode Core	250°C
Ceramic-to-Metal-Seals	250°C
Operating Position	Any
Cooling	Forced Air
Net Weight	4.6 ounces
Shipping Weight (Approximate)	1 pound

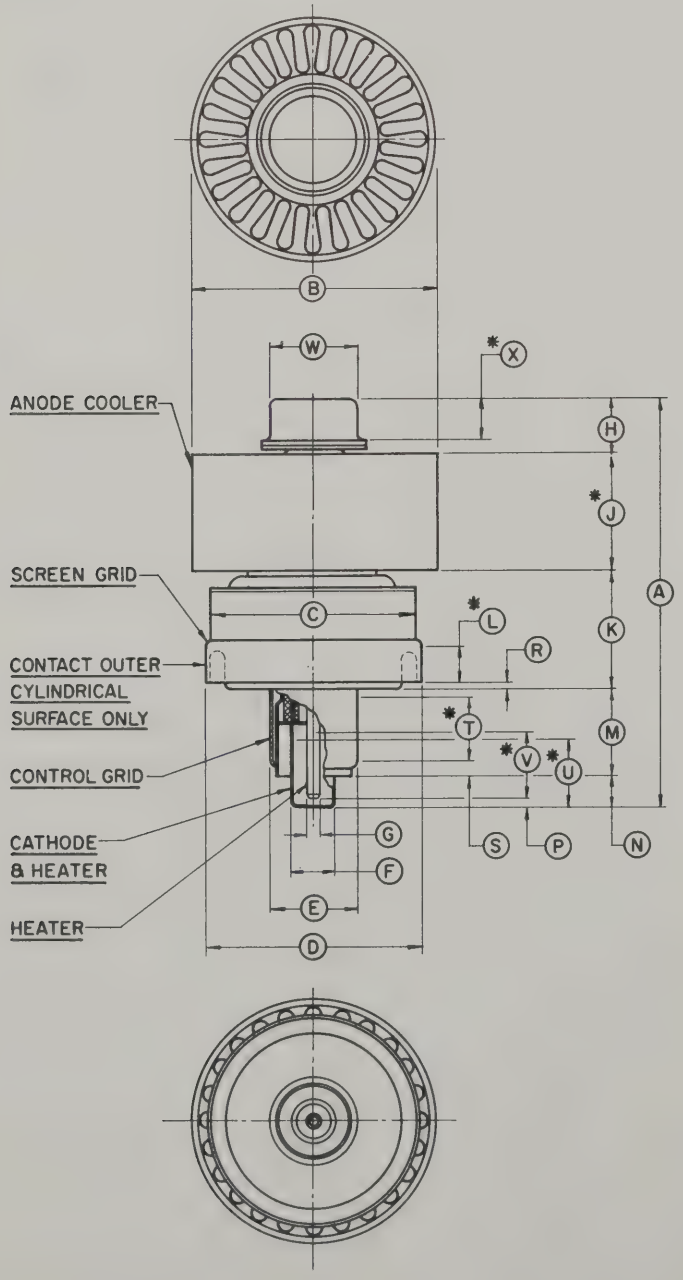
MAXIMUM RATINGS

	Class-C Plate Mod	Class-C Teleg or FM	Class-AB Audio or SSB	
D-C PLATE VOLTAGE	1500	2000	2000	MAX. VOLTS
D-C SCREEN VOLTAGE	300	300	400	MAX. VOLTS
D-C GRID VOLTAGE	-250	-250	---	MAX. VOLTS
D-C PLATE CURRENT	200	250	250	MAX. MA.
PLATE DISSIPATION	165	250	250	MAX. WATTS
SCREEN DISSIPATION	12	12	12	MAX. WATTS
GRID DISSIPATION	2	2	2	MAX. WATTS

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TYPICAL OPERATION	D-C Plate Voltage (Volts)	Driving Power (Watts)	Input Power (Watts)	Output Power (Watts)
R-F Amplifier at 500 Mc: (Excluding circuit losses)				
Class-C Telegraphy or FM Telephony	2000	--	500	225
Plate-Modulated Telephony (Carrier)	1500	--	300	140
Class-B Television Visual at 216 Mc:				
Peak-Sync Level	1250	9	380	250
Black Level	1250	6	285	140
Plate-Pulsed Oscillator at 1200 Mc:	7000	--	42,000	17,000

COOLING-At sea level, with an inlet air temperature of 20° C (68° F), and air-flow rate of 4 cfm (Base-to-Anode-Direction) through the anode cooler is required to cool the tube when operating at rated maximum plate dissipation. Under these conditions, 4 cfm corresponds to a pressure difference across the anode cooler of 0.12 inch of water column. Sufficient air must be circulated to the base of the tube to maintain desired seal temperatures; required air flow depends upon socket design.



DIMENSIONS		
REF.	MIN.	MAX.
A		2.813
B	1.610 DIA.	1.640 DIA.
C		1.406 DIA.
D	1.410 DIA.	1.440 DIA.
E	.587 DIA.	.597 DIA.
F	.317 DIA.	.327 DIA.
G	.088 DIA.	.098 DIA.
H		.358
J	.710	.790
K	.740	.820
L	.187	
M	.500	.580
N	.235	.265
P	.032	.062
R	.020 NOM.	
S	.125 NOM.	
T	11/32	
U	13/32	
V	15/32	
W	.559	.573
X	.240	.280

Printed in U.S.A. 82587

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

TENTATIVE DATA

4CX300A

CERAMIC POWER TETRODE



The Eimac 4CX300A is a compact integral-finned external-anode power tetrode having a maximum plate-dissipation rating of 300 watts. The 4CX300A may be operated at frequencies up to 500 megacycles.

The all-ceramic-and-metal construction and the internally-unitized electrode structure combine to make the 4CX300A especially durable and free from mechanically-induced noise under conditions of severe acceleration caused by shock or vibration.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage (See "Application")		6.0		volts
▶ Current (E_f = 6.0 volts)	2.2		3.2	amperes
Amplification Factor (Grid to Screen)	4.0		5.6	
Transconductance (I_b = 200 ma.)		12,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	25		33	uuf
▶ Output	3.5		4.5	uuf
Feedback			0.06	uuf

	Min.	Nom.	Max.	
Direct Interelectrode Capacitances, Grounded Grid and Screen:				
Input	-	16.2		uuf
▶ Output	3.5		4.5	uuf
Feedback	-	0.01		uuf
Frequency for Maximum Ratings	-	-	500	mc

MECHANICAL

Base	Special, breechblock terminal surfaces
Recommended Socket	Eimac SK-700 Series
Operating Position	Any
Maximum Operating Temperatures:	
▶ Ceramic-to-Metal Seals	- 225° C
Anode Core	- 250° C
Cooling	Forced Air
Maximum Over-All Dimensions:	
Height	2.5 inches
Diameter	1.65 inches
▶ Net Weight	4 ounces
▶ Shipping Weight (Approximate)	1 pound

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	500	1000	1500	2000	2500***	2000	volts
D-C Screen Voltage	250	250	250	250	250	250	volts
D-C Grid Voltage	—90	—90	—90	—90	—90	—90	volts
D-C Plate Current	250	250	250	250	250	250	ma
D-C Screen Current*	45	38	21	19	16	10**	ma
D-C Grid Current*	35	31	28	26	25	25**	ma
Peak R-F Grid Voltage*	114	114	112	112	111	—	volts
Driving Power*	4.0	3.5	3.2	2.9	2.8	—	watts
Plate Input Power	125	250	375	500	625	500	watts
Plate Output Power	70	190	280	390	500	225**	watts
Heater Voltage						5.5	volts

*Approximate values.
**Measured values for a typical cavity amplifier circuit at 500 Mc.
***For operation below 250Mc. only.

▶ Indicates change from sheet dated 12-4-58

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AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	200	200	200	200	ma
Max-Signal D-C Plate Current	500	500	500	500	ma
Max-Signal D-C Screen Current	20	16	10	8	ma
Effective Load, Plate to Plate	3500	6200	9500	11,600	ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50	50	volts
Driving Power	0	0	0	0	watts
Max-Signal Plate Output Power	240	430	600	800	watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier conditions)

MAXIMUM RATINGS

▶ D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	100	100	100	100	ma
D-C Plate Current	150	150	150	150	ma
D-C Screen Current*	—3	—4	—4	—4	ma
Peak R-F Grid Voltage*	25	25	25	25	volts
Plate Output Power	30	50	65	85	watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

▶ D-C PLATE VOLTAGE	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	300 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Peak-envelope conditions except where noted)

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	350	volts
D-C Grid Voltage[1]	—55	—55	—55	—55	volts
Zero-Signal D-C Plate Current	100	100	100	100	ma
Peak R-F Grid Voltage*	50	50	50	50	volts
D-C Plate Current	250	250	250	250	ma
D-C Screen Current*	10	8	5	4	ma
Plate Input Power	250	375	500	625	watts
Plate Output Power	120	215	300	400	watts
Two-Tone Average D-C Plate Current	190	190	190	190	ma
Two-Tone Average D-C Screen Current*	2	—1	—2	—2	ma

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	200 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	500	1000	1500	volts
D-C Screen Voltage	250	250	250	volts
D-C Grid Voltage	—100	—100	—100	volts
D-C Plate Current	200	200	200	ma
D-C Screen Current*	31	22	20	ma
D-C Grid Current*	15	14	14	ma
Peak R-F Grid Input Voltage*	118	117	117	volts
Driving Power*	1.8	1.7	1.7	watts
Plate Input Power	100	200	300	watts
Plate Output Power	60	145	235	watts

*Approximate values.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. The driving power and output power shown are substantially correct at frequencies below 175 Mc. Allowance must be made for grid and plate circuit losses. At frequencies above 175 Mc. additional allowance must be made for high-frequency effects within the tube itself. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct r-f driving voltage is applied.

▶ Indicates change from sheet dated 12-4-58

APPLICATION

MECHANICAL

Mounting—The 4CX300A may be operated in any position. Recommended sockets for the 4CX300A are the Eimac Air-System Sockets type SK-700 (ungrounded cathode) or type SK-710 (cathode and one heater contact grounded). Both sockets provide connections to all electrodes except the anode and each incorporates a screen by-pass capacitor of approximately 1100 uuf. The SK-606 chimney is recommended for use with the SK-700 and SK-710 sockets.

Other sockets suitable for use with the 4CX300A include the SK-740, SK-760, and SK-770. These sockets do not incorporate screen by-pass capacitors. The SK-760 and SK-770 incorporate integral air chimneys. Screen contacts are connected to the mounting flange in the SK-770 and are, therefore, grounded when the socket is installed in the usual manner.

▶ **Cooling**—The maximum rated ceramic-to-metal seal temperature for the 4CX300A is 225°C. Adequate forced-air cooling must be provided to assure that this maximum temperature rating is not exceeded. Airflow requirements to maintain seal temperatures at 175°C in 50°C ambient air are tabulated below.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
100	2.8	0.11	4.1	0.16
150	4.8	0.27	7.0	0.40
200	6.9	0.49	10.0	0.72
250	9.2	0.80	13.5	1.20
300	11.7	1.20	17.2	1.76

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At high altitudes and high ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using the maximum rated temperature as the criterion for satisfactory cooling.

Cooling effectiveness should also be determined on an individual basis if the 4CX300A is operated immersed in an insulating fluid such as silicone oil, again using the maximum rated temperature as the criterion.

Impact and Vibration—The 4CX300A is designed to operate under impact or vibration capable of disabling a conventional tube of similar power capabilities. Impact forces up to 50g with 11-millisecond duration, or vibratory accelerations up to 20g at frequencies from 20 to 2000 cycles per second, will not destroy a normal 4CX300A unless unduly prolonged.

It is not suggested that the 4CX300A be subjected to abusive treatment unnecessarily, but in applications where operation under severe environmental conditions is unavoidable the 4CX300A will provide more reliable service than will conventional tubes.

▶ Indicates change from sheet dated 12-4-58

ELECTRICAL

Heater Operation—The rated heater voltage for the 4CX300A is 6.0 volts. At frequencies higher than 300 megacycles the heater voltage should be reduced according to the following schedule:

Frequency (Mc.)	Heater Voltage (Volts)
Up to 300	6.00
300 to 400	5.75
400 to 500	5.50

The heater voltage must be maintained within ± 5% of the selected operating voltage if variations in circuit performance are to be minimized and best tube life obtained.

Cathode Operation—The 4CX300A employs a cylindrical indirectly-heated oxide-coated unipotential cathode. The minimum warm-up time is 30 seconds when rated heater voltage is applied.

Grid Operation—The 4CX300A control grid has a maximum dissipation rating of 2.0 watts, and precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the Typical Operation sections of the data sheet whenever possible.

At frequencies higher than 300 Mc., the driving power required by the circuits associated with the tube begins to increase, until at 500 Mc., as much as 30 watts of driving power may be required. The power dissipated by the control grid increases only slightly, however, in spite of the greatly increased driving power required by the circuit. Satisfactory 500-megacycle operation of the 4CX300A in a stable, "straight-through" amplifier is indicated by grid-current values below approximately 25 milliamperes.

In class-A and class-AB_1 amplifiers, where no grid current flows, the grid bias voltage may be applied through a resistor. The maximum permissible series resistance per tube is 100,000 ohms.

Screen Operation—The maximum rated screen dissipation for the 4CX300A is 12 watts. The maximum rated d-c screen supply voltage is 300 volts when the tube is operated in class-C amplifier or oscillator service, and 400 volts when the tube is operated in class-AB or class-B amplifier service.

Under certain operating conditions the screen current of a tetrode may reverse. This makes it dangerous to rely on a screen-dropping resistor or a series regulator to supply the screen voltage unless a bleeder or regulator tube is connected from screen to cathode. This bleeder should draw at least 15 milliamperes for each tube connected to the screen supply.

The power input to the screen can be calculated from the voltage and current whenever the screen-to-cathode potential does not vary. Screen modulation or cathode driving of tetrode amplifiers can lead to errors in measurement of screen input when the effective voltage and current exceed the indicated d-c values. When there is reason to suspect that the screen input exceeds the indicated power, it is advisable to maintain the indicated screen power input below approximately 75% of the rated screen dissipation.

A screen by-pass capacitor of approximately 1100 uuf is incorporated in the body of the Eimac SK-700 and SK-710 Air-System Sockets and is adequate for

normal amplifier operation at high and ultra-high radio frequencies. Operation at low radio frequencies or audio frequencies may require that additional capacitance be connected externally. In the latter case, the screen by-pass capacitance within the socket helps to eliminate the high-frequency parasitic oscillations occasionally encountered in tetrode amplifiers.

The self-neutralizing frequency of the 4CX300A is above the useful high-frequency limit for the tube when either of the sockets with integral screen by-pass capacitors is used.

Plate Operation—The 4CX300A has a finned external anode for forced-air cooling. Connection to the anode may be made at the top cap or cylindrical cooler shell. The latter is usually used when the tube is installed in coaxial lines or cavities.

The absolute maximum plate-dissipation rating for the 4CX300A is 300 watts, which is also the rated maximum dissipation for class-C amplifier or oscillator applications and for class-B or class-AB amplifier applications. When the 4CX300A is used in plate-modulated amplifier applications, the plate-dissipation rating is 200 watts under carrier conditions, rising to 300 watts under 100% sine-wave modulation. Plate dissipation may be permitted to exceed the maximum rated value for brief periods, such as may occur while tuning.

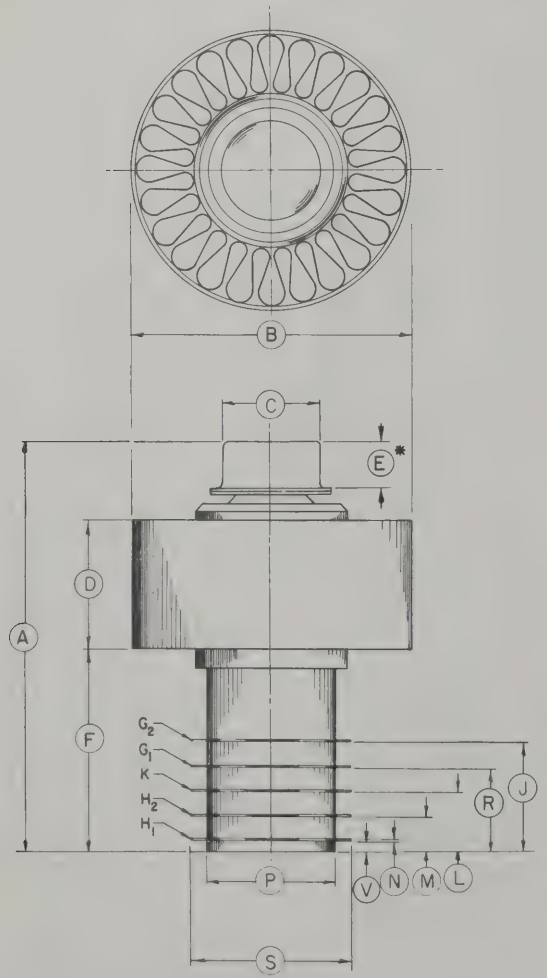
The maximum rated plate voltage for class-AB_1 operation at frequencies up to 500 megacycles is 2500 volts. In class-C telegraphy and plate-modulated service the maximum rated plate voltage for operation up to 500 megacyles is 2000 and 1500 volts respectively. However, at frequencies below 250 megacycles, a plate potential of 2500 volts may be used in class-C telegraphy and FM telephony service.

Modulation—The 4CX300A can be modulated by any of the methods commonly used with tetrode tubes. Its large reserve plate dissipation makes it especially suited for use in screen-modulated and linear amplifiers in which the plate efficiency is low.

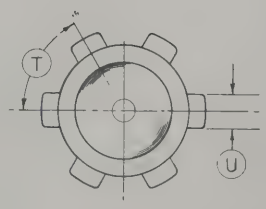
Plate modulation can be appplied to the 4CX300A when it is operated as a class-C amplifier. To obtain 100% modulation with minimum distortion the screen supply voltage should be modulated in phase with the modulation applied to the plate supply voltage. Screen voltage modulation factors between 0.75 and 1.00 may be used.

"Self-modulation" of the screen by means of a resistor in series with the screen supply line is not recommended because of the effects which require a bleeder from screen to cathode as described under "Screen Operation" above.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Eitel-McCullough, Inc. for information and recommendations.

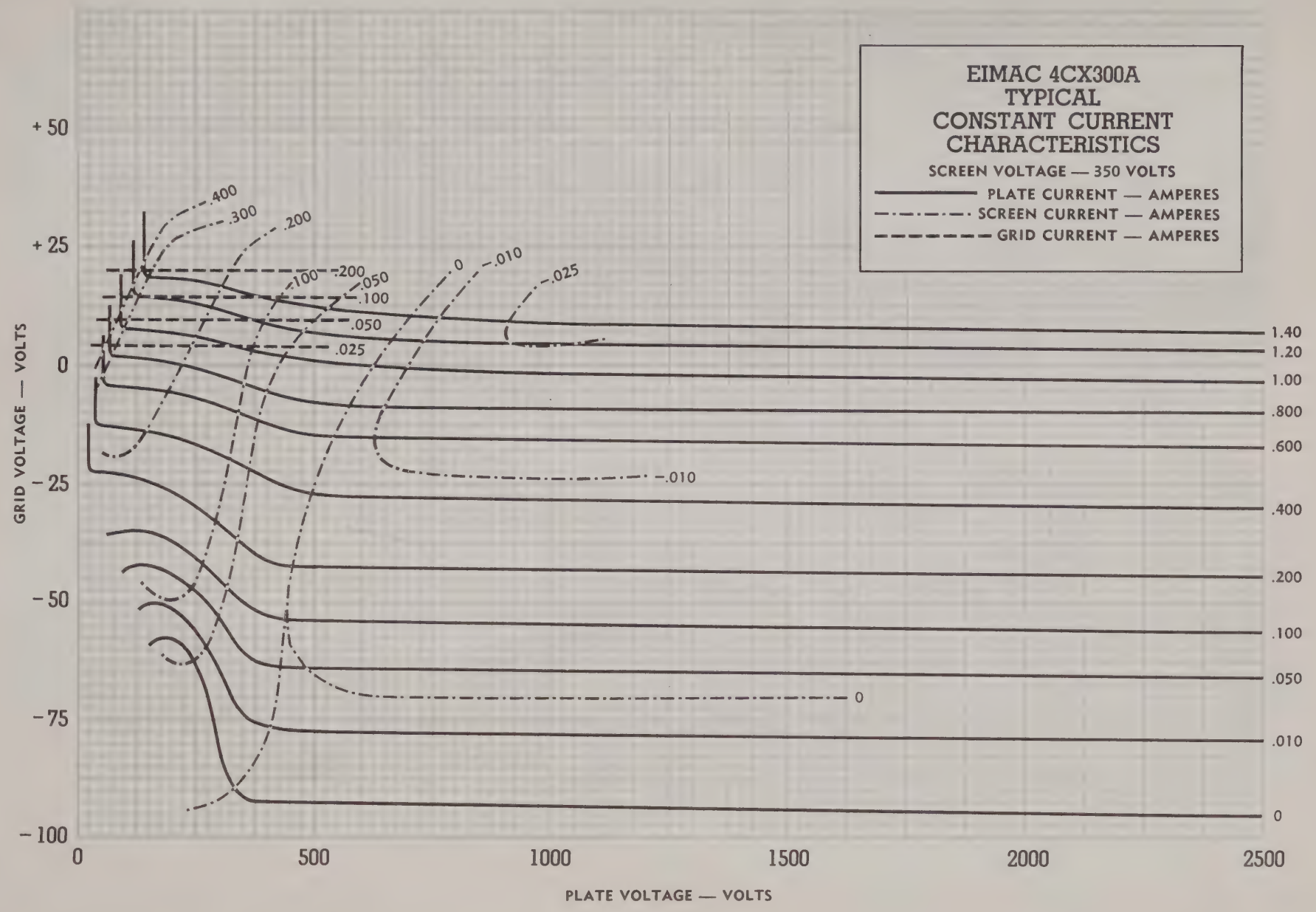


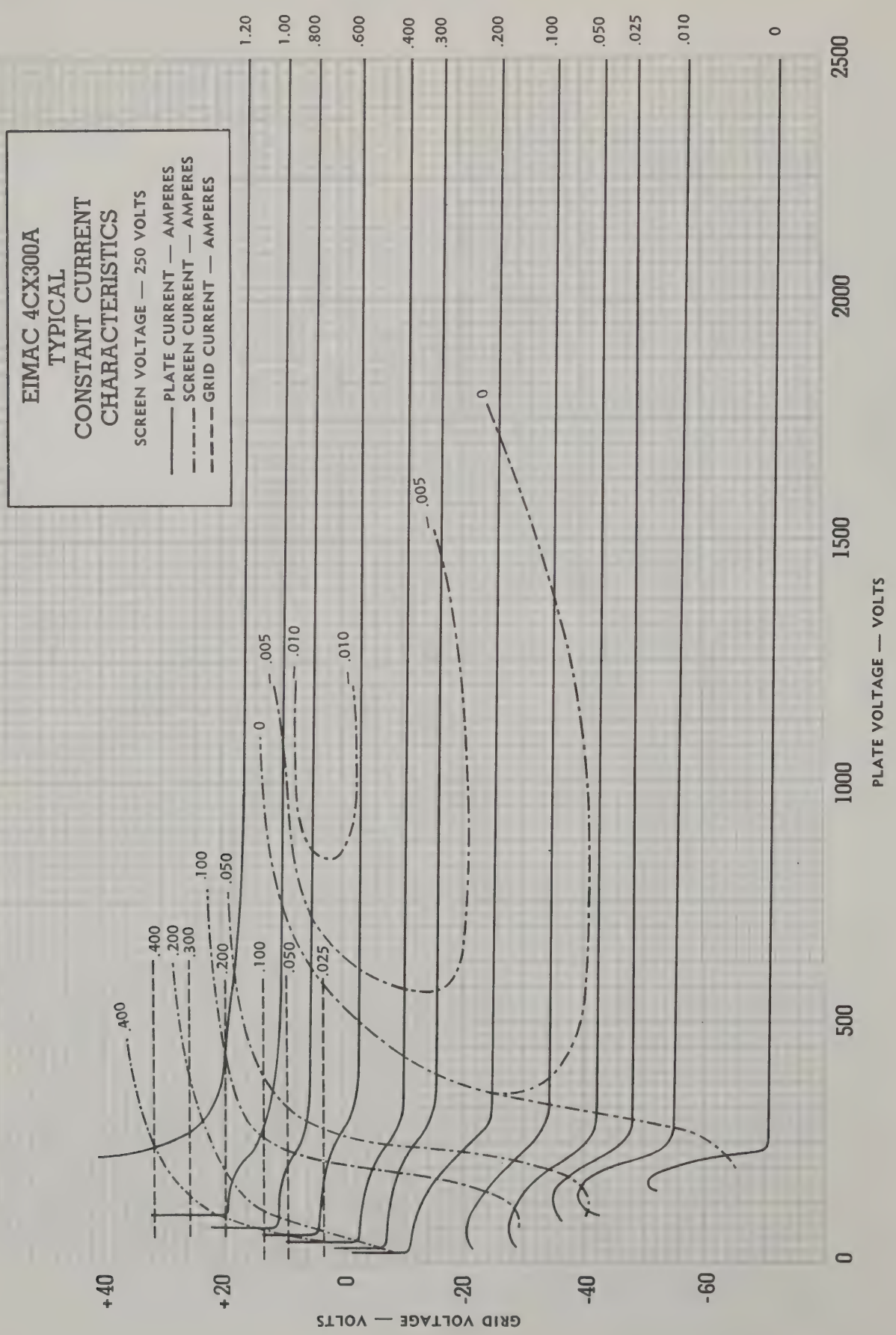
DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A	2.400	2.300	2.500
B	1.625	1.610	1.640
C	.566	.559	.573
D	.750	.710	.790
E		.240	.280
F	1.164	1.133	1.195
J	.622	.602	.642
L	.344	.329	.359
M	.203	.193	.213
N	.015	.010	.020
P	.755	.740	.770
R	.485	.470	.500
S	.946	.936	.956
T	60°		
U	.175	.170	.185
V	.061	.050	.072



*CONTACT SURFACE

▶ Indicates change from sheet dated 12-4-58


EIMAC 4CX300A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 350 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
+ 50
+ 25
0
− 25
− 50
− 75
− 100
GRID VOLTAGE — VOLTS
0
500
1000
1500
2000
2500
PLATE VOLTAGE — VOLTS
.400
.300
.200
.100
.200
.050
.100
.050
.025
0
.010
.025
.010
0
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0



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Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

TENTATIVE DATA

4CX1000A

CERAMIC POWER TETRODE



The Eimac 4CX1000A is a ceramic and metal, forced-air cooled, radial-beam tetrode with a rated maximum plate dissipation of 1000 watts. It is a low-voltage, high-current tube specifically designed for Class-AB_1 r-f linear-amplifier or audio-amplifier applications where its high gain and low distortion characteristics may be used to advantage. At its rated maximum plate voltage of 3000 volts, it is capable of producing 1680 watts of peak-envelope output power. Two 4CX1000As operating in Class-AB_1 will produce 3360 watts of audio power.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide Coated, Unipotential				
Heating Time	3			minutes
Heater: Voltage		6.0		volts
Current	9.5		11.5	amperes
Transconductance (I_b=1.0 ampere)		37,000		umhos
Direct Interelectrode Capacitances, Grounded Cathode:*				
Input	77		90	uuf
Output	11		13	uuf
Feedback			0.02	uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:*	Min.	Nom.	Max.	
Input		35		uuf
Output	11		13	uuf
Feedback			0.005	uuf
Frequency for Maximum Ratings			30	mc

*In shielded fixture.

MECHANICAL

Base	Special, breechblock terminal surfaces
Maximum Operating Temperatures:	
Ceramic-to-Metal Seals	200° C
Anode Core	250° C
Recommended Socket	Eimac SK-800 Series
Operating Position	Any
Maximum Over-All Dimensions:	
Height	4.75 inches
Diameter	3.36 inches
Net Weight	27 ounces
Shipping Weight (Approximate)	3 pounds

CLASS-AB_1 RADIO-FREQUENCY LINEAR AMPLIFIER

(Single Side-Band Suppressed-Carrier Operation)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. WATTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	325	325	325	volts
D-C Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal D-C Plate Current	250	250	250	ma
Single-Tone D-C Plate Current	1.0	1.0	0.9	amp
Two-Tone Average D-C Plate Current	700	700	640	ma
Zero-Signal D-C Screen Current*	—2	—2	—2	ma
Single-Tone D-C Screen Current*	35	35	35	ma
Two-Tone Average D-C Screen Current*	11	10	9	ma
Plate Output Power	1020	1450	1680	watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

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Supersedes sheet dated 8-15-57

CLASS-AB$_1$ AUDIO AMPLIFIER OR MODULATOR

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	1.0 MAX. AMP
PLATE DISSIPATION	1000 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	0 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	325	325	325	volts
D-C Grid Voltage[1]	—60	—60	—60	volts
Zero-Signal D-C Plate Current	500	500	500	ma
Max.-Signal D-C Plate Current	2.0	2.0	1.8	amps
Zero-Signal D-C Screen Current*	—4	—4	—4	ma
Max-Signal D-C Screen Current*	70	70	70	ma
Effective Load, Plate to Plate	1650	2400	3450	ohms
Driving Power	0	0	0	watts
Max-Signal Plate Output Power	2040	2900	3360	watts

*Approximate values.
[1]Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from the published characteristic curves and confirmed by direct tests. Adjustment of the grid bias to obtain the specified zero-signal plate current is assumed. When grid drive is applied, the screen voltage required to obtain the specified value of plate current without drawing grid current may vary somewhat from the typical values shown.

APPLICATION

MECHANICAL

Cooling—Sufficient cooling must be provided for the anode and ceramic-to-metal seals to maintain operating temperatures below the rated maximum values:

Ceramic-to-Metal Seals	200°C
Anode Core	250°C

A flow rate of 28 cubic feet per minute will be adequate for operation at maximum rated plate dissipation at sea level and with inlet air temperatures up to 40°C. Under these conditions, 28 cfm of air flow corresponds to a pressure difference across the tube and socket of 0.25 inch of water column. Experience has shown that if reliable long-life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube.

At higher altitudes increased air flow will be required. For example, at an altitude of 10,000 feet, a flow rate of 40 cfm will be required and will be obtained with a pressure drop across tube and socket of 0.35 inch of water column. In selecting a blower for use at high altitudes, care must be taken to assure that the blower is designed to deliver the desired volume of air at the corresponding pressure drop and *at the particular altitude.*

In cases where there is any doubt regarding the adequacy of the supplied cooling, it should be borne in mind that operating temperature is the sole criterion of cooling effectiveness. Surface temperatures may be easily and effectively measured by using one of the several temperature-sensitive paints or sticks available from various chemical or scientific-equipment suppliers. When these materials are used, extremely thin applications must be made to avoid interference with the transfer of heat from the tube to the air stream, which would cause inaccurate indications.

ELECTRICAL

Heater—The rated heater voltage for the 4CX1000A is 6.0 volts. The voltage, as measured at the socket, should be maintained at this value to minimize variations in operation and to obtain maximum tube life. In no case should the voltage be allowed to exceed 5% above or below the rated value.

The cathode and one side of the heater are internally connected.

It is recommended that the heater voltage be applied for a period of not less than 3 minutes before other operating voltages are applied. From an initial cold condition, tube operation will stabilize after a period of approximately 5 minutes.

Control-Grid Operation—The grid dissipation rating of the 4CX1000A is zero watts. The design features which make the tube capable of maximum power operation without driving the grid into the positive region also make it necessary to avoid positive-grid operation.

Although the average grid-current rating is zero, peak grid currents of less than one milliampere as read on a one-milliampere meter may be permitted to flow for peak-signal monitoring purposes.

Screen-Grid Operation—Tetrode tubes may exhibit reversed screen current to a greater or lesser degree depending on individual tube design. This characteristic is prominent in the 4CX1000A and, under some operating conditions, indicated negative screen currents in the order of 25 milliamperes may be encountered.

The maximum rated power dissipation for the screen grid in the 4CX1000A is 12 watts and the screen power should be kept below this level. The product of the peak screen voltage and the indicated d-c screen current approximates the screen input power except when the screen current indication is near zero or negative. In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the d-c screen voltage. Experience has shown that the screen will operate within the limits established for this tube if the indicated screen current, plate voltage and drive voltage approximate the 'Typical Operation" values.

The screen supply voltage must be maintained constant for any values of negative and positive screen currents that may be encountered. Dangerously high plate currents may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization may be accomplished in several different ways. A bleeder resistor may be connected from screen to cathode; a combination of VR tubes may be connected from screen to cathode; or an electron-tube regulator circuit may be used in the

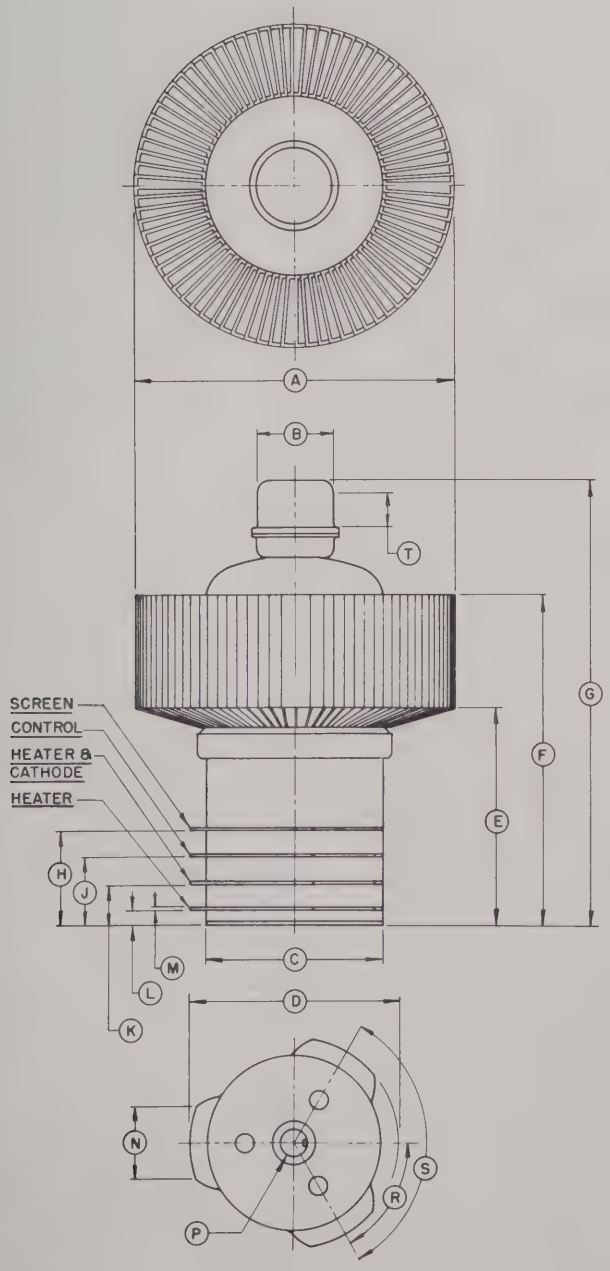
screen supply. It is absolutely essential to use a bleeder if a series electron-tube regulator is employed. The screen bleeder current should approximate 70 milliamperes to adequately stabilize the screen voltage. It should be observed that this bleeder power may be usefully employed to energize low-power stages of the transmitter.

Plate Operation—The maximum rated plate dissipation power is 1000 watts. Except for brief periods during circuit adjustments, this maximum value should not be exceeded.

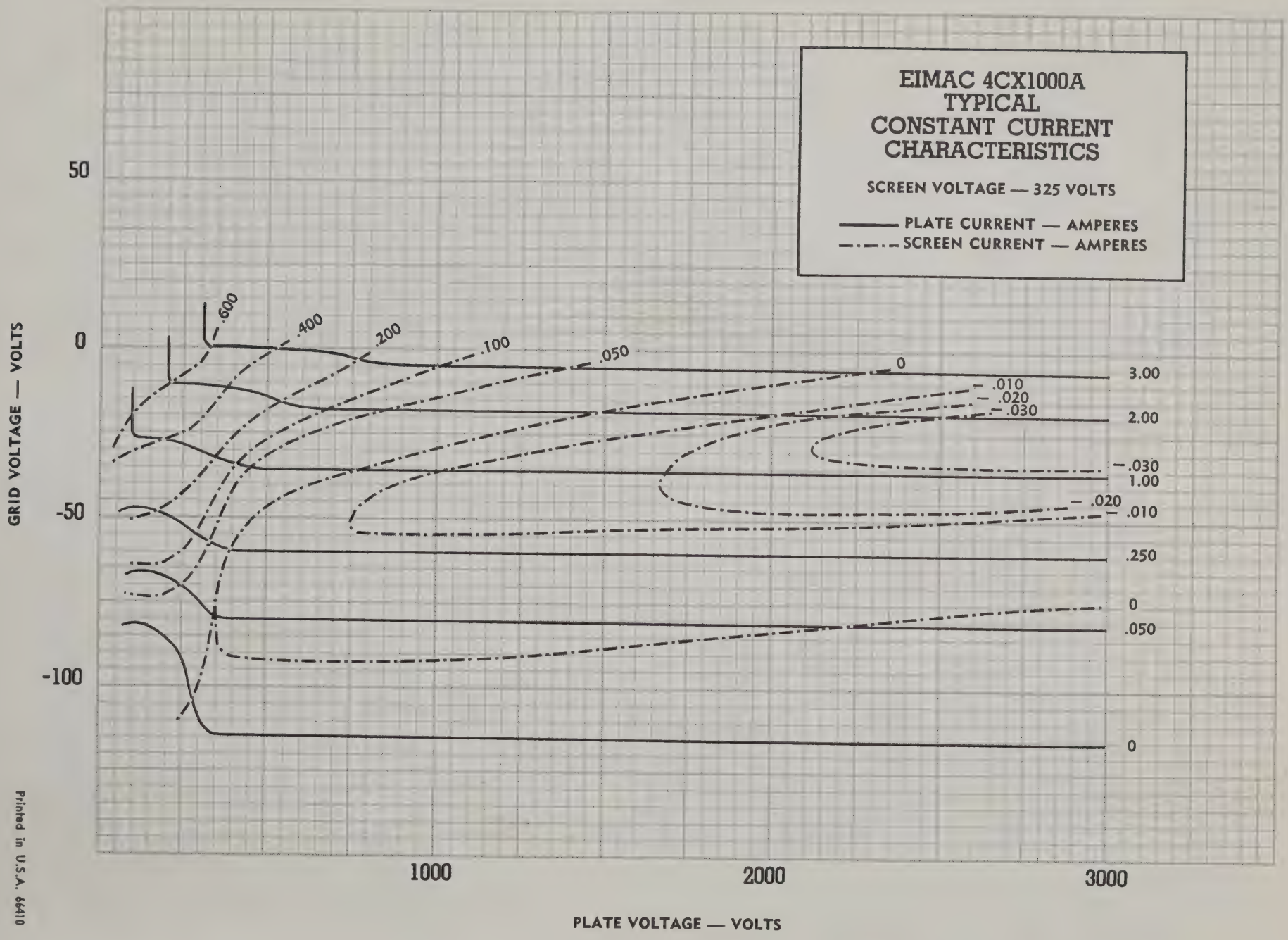
The top cap on the anode cooler may be used as a plate terminal or a circular clamp or spring-finger collet encircling the cylindrical outer surface of the anode cooler may be used.

Points of electrical contact with the anode cooler should be kept clean and free of oxide to minimize radio-frequency losses. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Special Applications—If it is desired to operate this tube under conditions different from those given here, write to the Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A	3.350	3.340	3.360
B	.8125	.810	.815
C	1.875	1.870	1.890
D	2.265 DIA.	2.254 DIA.	2.278 DIA.
E	2.234	2.195	2.380
F	3.500	3.410	3.550
G	4.720	4.690	4.750
H	.980	.950	1.000
J	.705	.695	.720
K	.425	.400	.450
L	.155	.145	.170
M	.023	.019	.026
N	.750	.700	.800
P	.321 DIA.	.316 DIA.	.326 DIA.
R	60°		
S	120°		
T	.410	.360	.460



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Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

4CX5000A
RADIAL-BEAM POWER TETRODE



The Eimac 4CX5000A is a compact high-power ceramic and metal tetrode cooled by forced air. It is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megacycles and is particularly suited for use as a linear single-sideband amplifier, class-AB$_1$ audio amplifier, or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The rated plate dissipation is five kilowatts for most classes of service and six kilowatts for class-AB operation.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated Tungsten				
Voltage		7.5		volts
Current	73		78	amperes
Amplification Factor (Grid-Screen)	4.25		5.0	
Direct Interelectrode Capacitances, Grounded Cathode:				
Input		106		uuf
Output		18		uuf
Feedback		0.75		uuf

Direct Interelectrode Capacitances, Grounded Grid and Screen:	Nom.	
Input	47	uuf
Output	18	uuf
Feedback	0.14	uuf

MECHANICAL

Base	Special concentric	
Maximum Seal Temperature	250° C	
Maximum Anode-Core Temperature	250° C	
Recommended Socket	Eimac SK-300	
Operating Position	Axis vertical, base up or down	
Maximum Dimensions:		
Height	9.13	inches
Diameter	4.94	inches
Cooling	Forced air	
Net Weight	9.5	pounds
Shipping Weight (Approximate)	22	pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 30 megacycles)

Class-C Telegraphy (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	3 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	500	volts
D-C Grid Voltage	—350	volts
D-C Plate Current	2.8	amperes
D-C Screen Current	0.5	ampere
D-C Grid Current	0.25	ampere
Peak R-F Grid Voltage	590	volts
Driving Power	150	watts
Plate Dissipation	5000	watts
Plate Output Power	16,000	watts

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RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR (From 30 to 110 megacycles)

Class-C Telegraphy or FM Telephony (Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
30 to 60 megacycles	7000 MAX. VOLTS
60 to 110 megacycles	6500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT:	
30 to 60 megacycles	2.8 MAX. AMPERES
60 to 110 megacycles	2.6 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies between 88 and 108 megacycles)

D-C Plate Voltage	6500	volts
D-C Screen Voltage	750	volts
D-C Grid Voltage	—350	volts
D-C Plate Current	2.3	amperes
D-C Screen Current	0.2	ampere
D-C Grid Current	0.05	ampere
Driving Power	25	watts
Useful Output Power	10,000	watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPERES
PLATE DISSIPATION*	3500 MAX. WATTS
SCREEN DISSIPATION	250 MAX. VOLTS
GRID DISSIPATION	75 MAX. WATTS

*Corresponds to 5000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megacycles)

D-C Plate Voltage	5000	volts
D-C Screen Voltage	500	volts
Peak A-F Screen Voltage (For 100-percent modulation)	450	Volts
D-C Grid Voltage	—400	volts
D-C Plate Current	1.4	amperes
D-C Screen Current	0.26	ampere
D-C Grid Current	0.05	ampere
Peak R-F Grid Voltage	520	volts
Grid Driving Power	25	watts
Plate Dissipation	1100	watts
Plate Output Power	5.8	kilowatts

SCREEN-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

(Carrier conditions except where noted)

MAXIMUM RATINGS, Class-C Telephony (Per Tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C PLATE CURRENT	3.0 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 megacycles, per tube)

D-C Plate Voltage	7500	7500	volts
D-C Screen Voltage	350	350	volts
Peak A-F Screen Voltage (For 100-percent modulation)	550	550	volts
D-C Grid Voltage	—300	—300	volts
D-C Plate Current	0.9	1.14	amperes
D-C Screen Current*	—0.01	—0.01	amperes
D-C Grid Current	0.015	0.03	amperes
Peak R-F Grid Voltage	350	375	volts
Grid Driving Power	7	11	watts
R-F Load Impedance	2000	1600	ohms
Plate Dissipation	4000	5000	watts
Useful Output Power	2750	3550	watts

*D-C Screen Current is a function of loading; values of plus or minus 20 milliamperes may be considered typical at carrier level.

NOTE: Two tubes can be employed under conditions listed in the first column to obtain more than five kilowatts plate output power. Likewise, three tubes can be utilized at conditions listed in the second column to obtain better than ten kilowatts output power.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, two tubes

D-C Plate Voltage	4000	5000	6000	7000	volts
D-C Screen Voltage	1250	1250	1250	1250	volts
D-C Grid Voltage	—270	—280	—310	—325	volts
Max.-Signal Plate Current	5.10	4.40	4.25	3.65	amperes
Zero-Signal Plate Current	1.25	1.00	0.83	0.70	amperes
Max-Signal Screen Current	0.35	0.33	0.30	0.24	amperes
Zero-Signal Screen Current	0	0	0	0	amperes
Peak A-F Driving Voltage	250	240	270	235	volts
Driving Power	0	0	0	0	watts
Load Resistance, Plate-to-Plate	1500	2370	2940	4100	ohms
Max.-Signal Plate Dissipation	4200	4200	4200	4200	watts
Max.-Signal Plate Output Power	11,500	13,500	17,000	17,500	watts

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, Peak-Envelope or Modulation-Crest Conditions, (Frequencies below 30 megacycles)

D-C Plate Voltage	7500	volts
D-C Screen Voltage	1250	volts
D-C Grid Voltage*	—300	volts
Max.-Signal Plate Current	1.9	amperes
Zero-Signal Plate Current	0.50	ampere
Max.-Signal Screen Current	0.20	ampere
Peak R-F Grid Voltage	300	volts
Driving Power	0	watts
Plate Dissipation	4200	watts
Plate Output Power**	10,000	watts

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or r-f output power at crest of modulation envelope.

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

APPLICATION

MECHANICAL

Mounting—The 4CX5000A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—The Eimac Air-System Socket Type SK-300 is designed especially for the concentric base terminals of the 4CX5OOOA. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins.

Cooling—The maximum temperature rating for the external surfaces of the 4CX5OOOA is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic-metal seals below 250°C. Air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below.

	SEA LEVEL		10,000 FEET	
Plate Dissipation* (Watts)	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
2000	100	0.6	146	0.9
3000	160	1.4	230	2.0
4000	230	2.8	330	4.0
5000	310	4.0	450	5.8
6000	400	5.1	580	7.4

*Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

At other altitudes and ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4CX5000A is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4CX5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

Control Grid Operation—The 4CX5000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

Screen-Grid Operation—The power dissipated by the screen of the 4CX5000A must not exceed 250 watts.

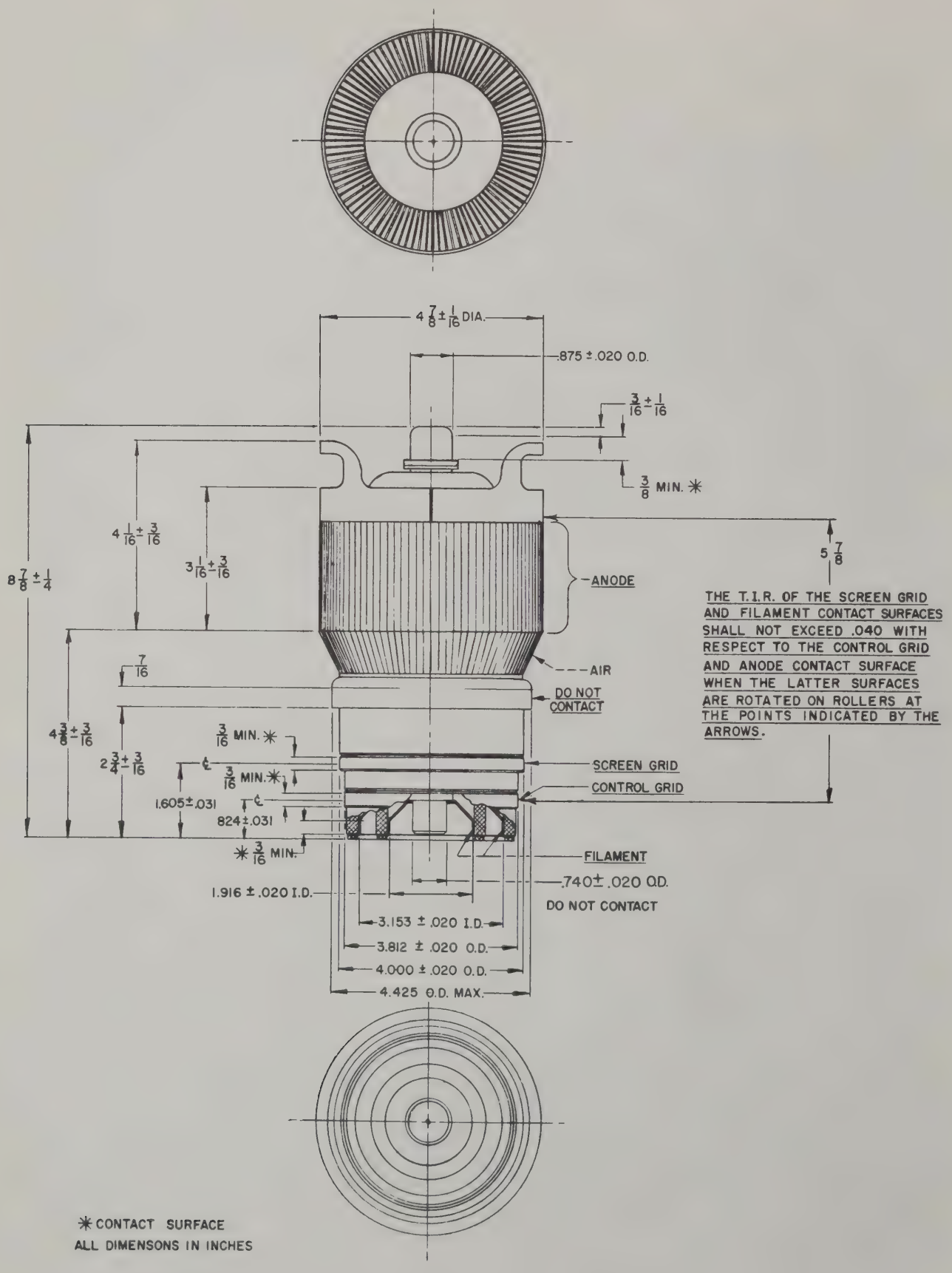
Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

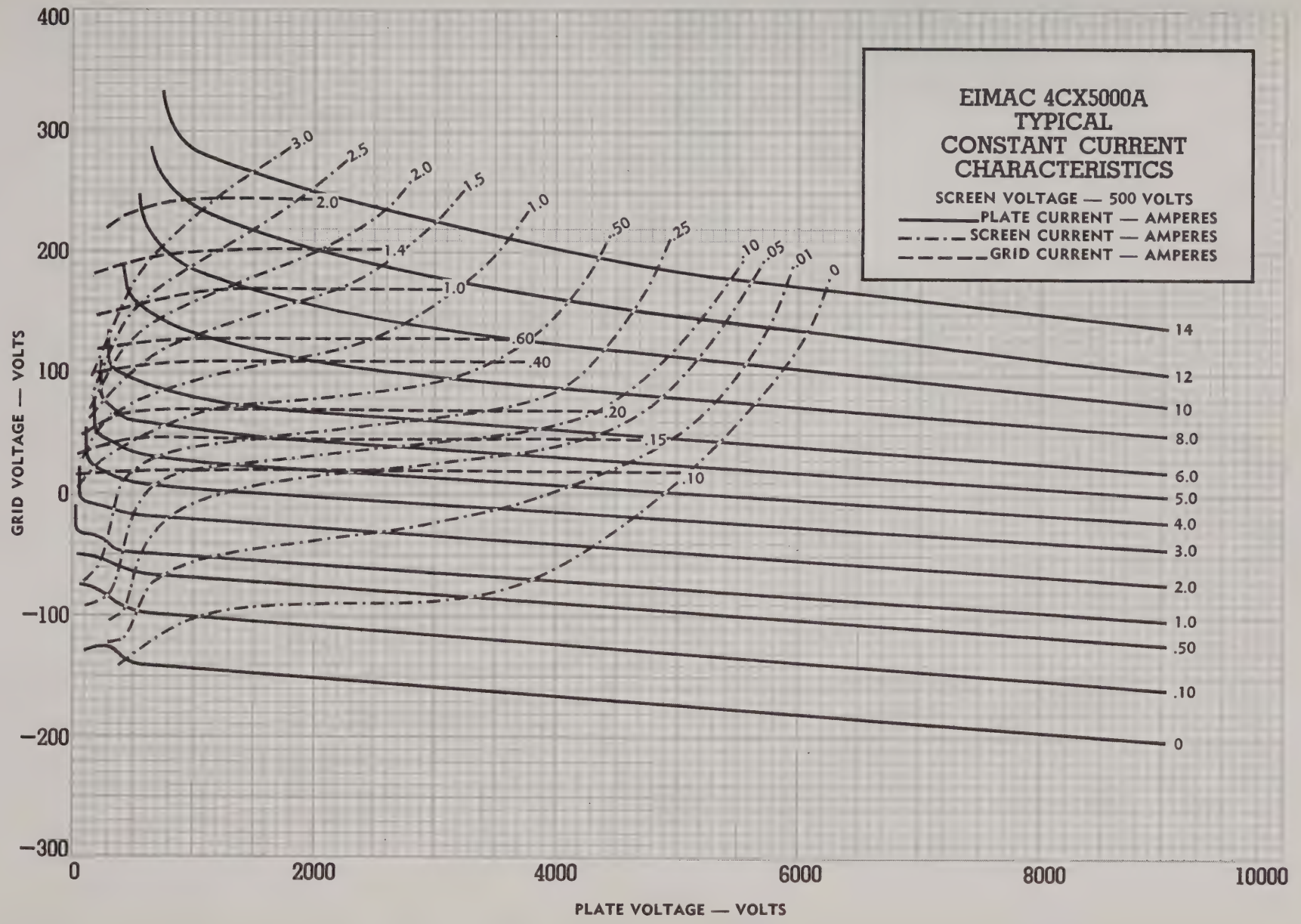
Plate Dissipation—The plate-dissipation rating for the 4CX5000A is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts.

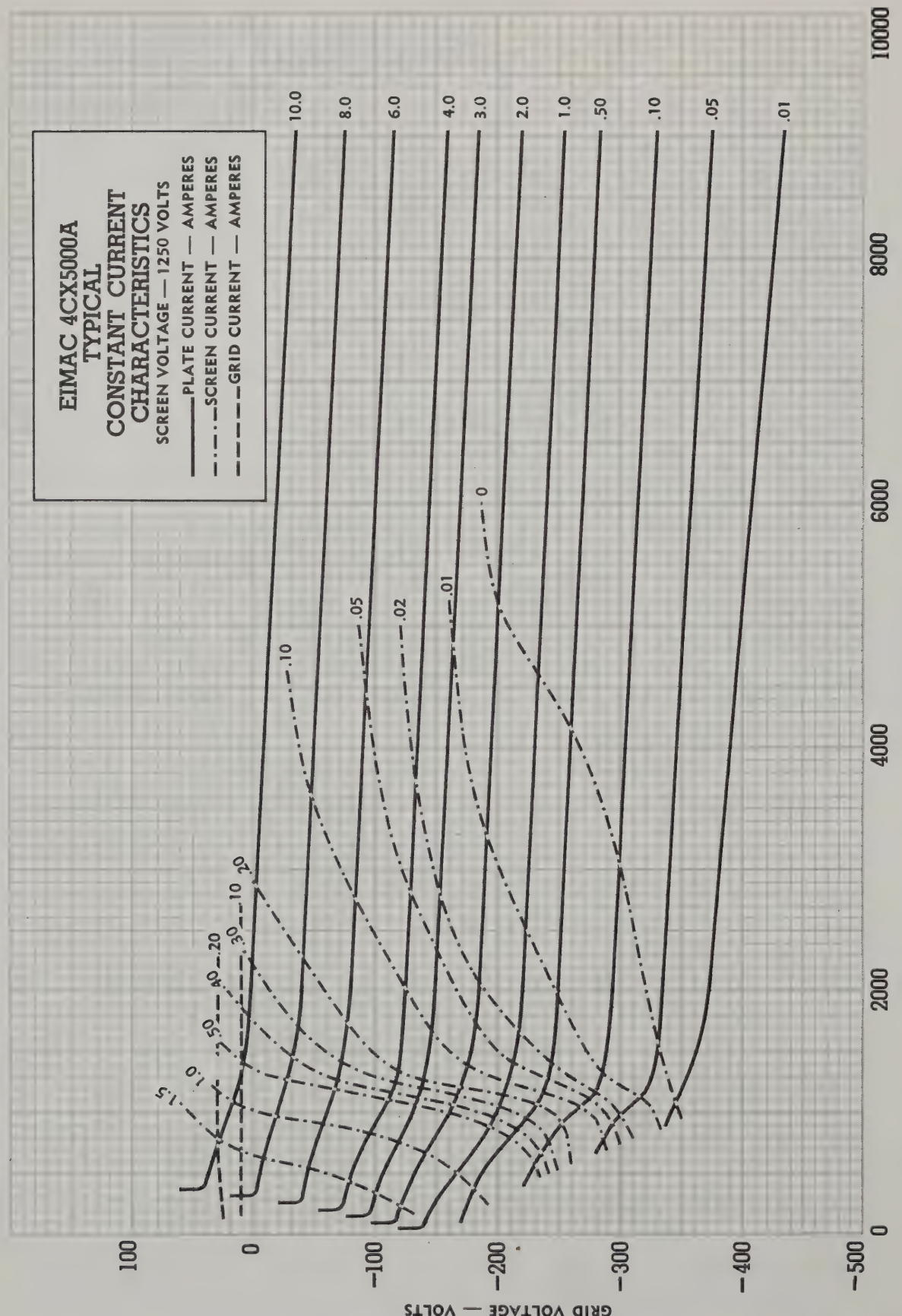
When the 4CX5000A is operated as a plate-modulated r-f power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Department, Eitel-McCullough, Inc., 301 Industrial Road, San Carlos, California, for information and recommendations.



✳ CONTACT SURFACE
ALL DIMENSONS IN INCHES


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
3.0
2.5
2.0
1.5
1.0
.50
.25
.10
.05
.01
0
2.0
1.4
1.0
.60
.40
.20
.15
.10
14
12
10
8.0
6.0
5.0
4.0
3.0
2.0
1.0
.50
.10
0



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4PR60A

RADIAL-BEAM PULSE TETRODE

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MODULATOR AMPLIFIER

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

The Eimac 4PR60A is a high-vacuum tetrode intended for pulse-modulator service in circuits employing inductive or resistive loads. This tube unilaterally replaces the 715C and the 5D21.

▶ The 4PR60A has a maximum plate dissipation rating of 60 watts, is cooled by radiation and convection, and delivers pulse power output in the range of 300 kilowatts with one kilowatt of pulse driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Oxide-coated, Unipotential

Heater Voltage	26.0	volts
Heater Current	2.25	amperes
Minimum Heating Time	3	minutes

Direct Interelectrode Capacitances (Average)

Grid-Plate (without shielding)	0.3	μμf
Input	43.0	μμf
Output	9.0	μμf

MECHANICAL

Minimum Shock Test	200g
Base	Fits E. F. Johnson Co. Socket Number 122-234 or equivalent
Mounting Position	Any
Cooling	Radiation and Convection
Recommended Heat Dissipating Plate Connector	Eimac HR-8

Maximum Over-all Dimensions

Length	6	inches
Diameter	3 1/8	inches
Net Weight	12	ounces
Shipping Weight	1.75	pounds

RATINGS

MAXIMUM RATINGS—Pulse Modulator Service (Per Tube)

D-C PLATE VOLTAGE	20 MAX. KILOVOLTS
D-C SCREEN VOLTAGE[1]	1.5 MAX. KILOVOLTS
D-C GRID VOLTAGE[2]	—1.0 MAX. KILOVOLT
PEAK POSITIVE GRID VOLTAGE	300 MAX. VOLTS
PEAK PLATE CURRENT	18 MAX. AMPERES
PEAK POSITIVE PLATE VOLTAGE	25 MAX. KILOVOLTS
PLATE DISSIPATION (AVERAGE)	60 MAX. WATTS
SCREEN DISSIPATION (AVERAGE)	8 MAX. WATTS
SEAL TEMPERATURES	200 MAX. DEG. C

DUTY

For peak plate currents in excess of 5 amperes, the duty shall not exceed 0.001, and the product of peak current in amperes and pulse duration in microseconds shall not exceed 40. The tube shall not be operated for longer than 5 microseconds in any 100 microsecond interval.

For peak plate current values of less than 5 amperes, the pulse duration-current factor of 40 applies, and the plate dissipation rating of 60 watts determines the maximum permissible duty.

TYPICAL OPERATION

Pulse Modulator (Per Tube)

D-C Plate Voltage	15.8	20.0	kilovolts
Pulse Plate Current	14.0	16.0	amperes
D-C Screen Voltage	1.25	1.25	kilovolts
Pulse Screen Current*	4.0	3.0	amperes
D-C Grid Voltage	-600	-600	volts
Pulse Grid Current*	1.1	1.1	amperes
Pulse Positive Grid Voltage	100	100	volts
Duty	.001	.001	
Pulse Length	2	2	μsec
Peak Positive Plate Voltage	25	25	kilovolts
Peak Plate Current	16	18	amperes
Pulse Power Input	220	320	kilowatts
Pulse Power Output	210	305	kilowatts
Plate Output Voltage	15.0	19.0	kilovolts

[1]Screen grid series protective resistance shall be 20,000 ohms, minimum.

▶ [2]Control grid series resistance shall be 100,000 ohms, maximum.

*Approximate values.

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▶ Indicates change from sheet dated 8-15-52.

APPLICATION

MECHANICAL

Mounting—The 4PR60A may be mounted and operated in any position. A flexible connecting strap should be provided between the plate terminal and the external plate circuit.

The 4PR60A is designed to withstand 200g shocks of short duration transferred to the tube through clamps on the metal skirt. Such clamps must be shaped to fit the contour of the skirt and must be fastened to the tube before being tightened to the chassis in order that no distorting force will be applied. No lateral pressure or clamping action should be applied to the base pins or to any part of the tube other than the skirt. The skirt is internally connected to the cathode.

Adequate ventilation must be provided so that the seals and envelope under operating conditions do not exceed 200°C.

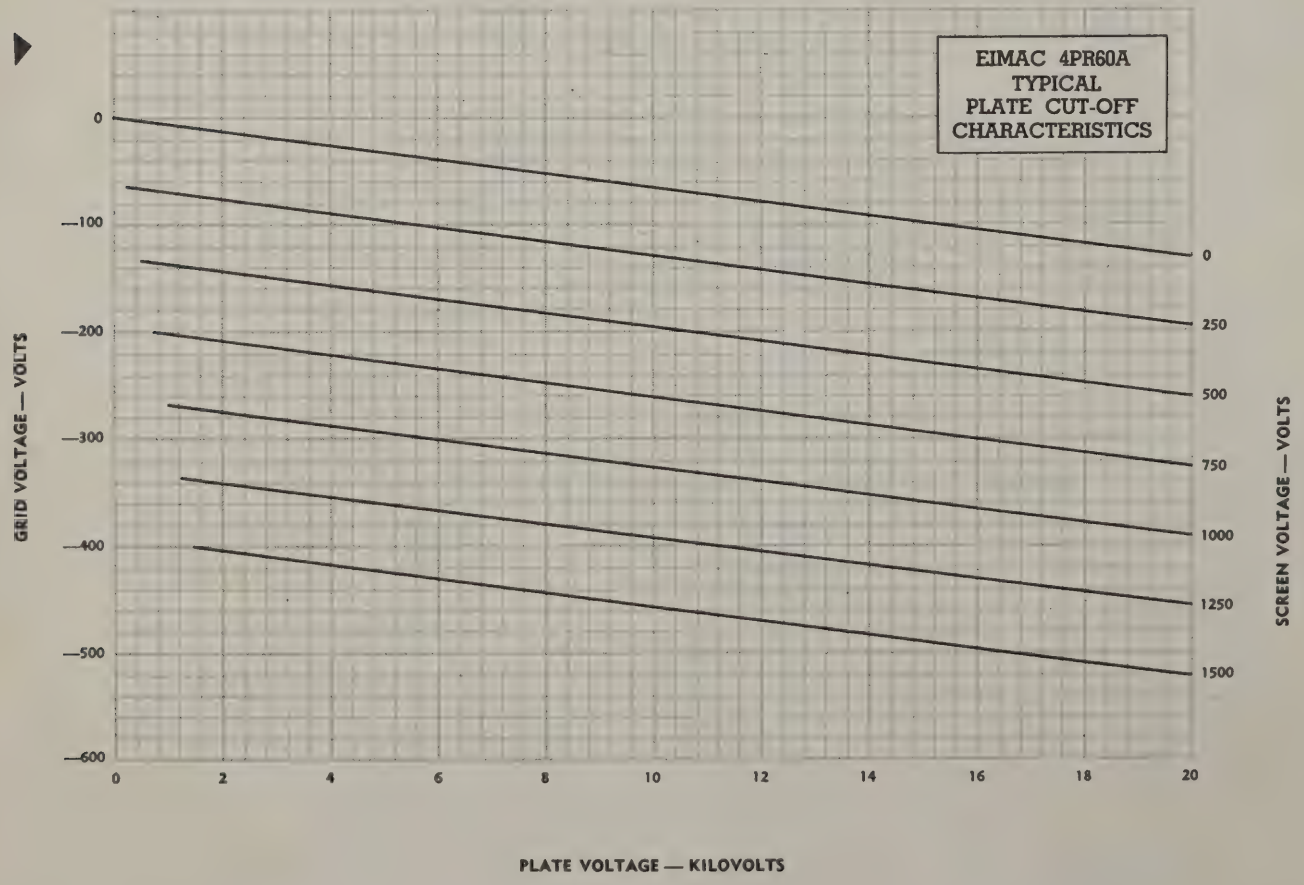
ELECTRICAL

Heater Voltage—The heater voltage, as measured directly at the heater pins, should be the rated value of 26.0 volts. Variations in heater voltage must be kept within the range from 23.4 to 28.6 volts.

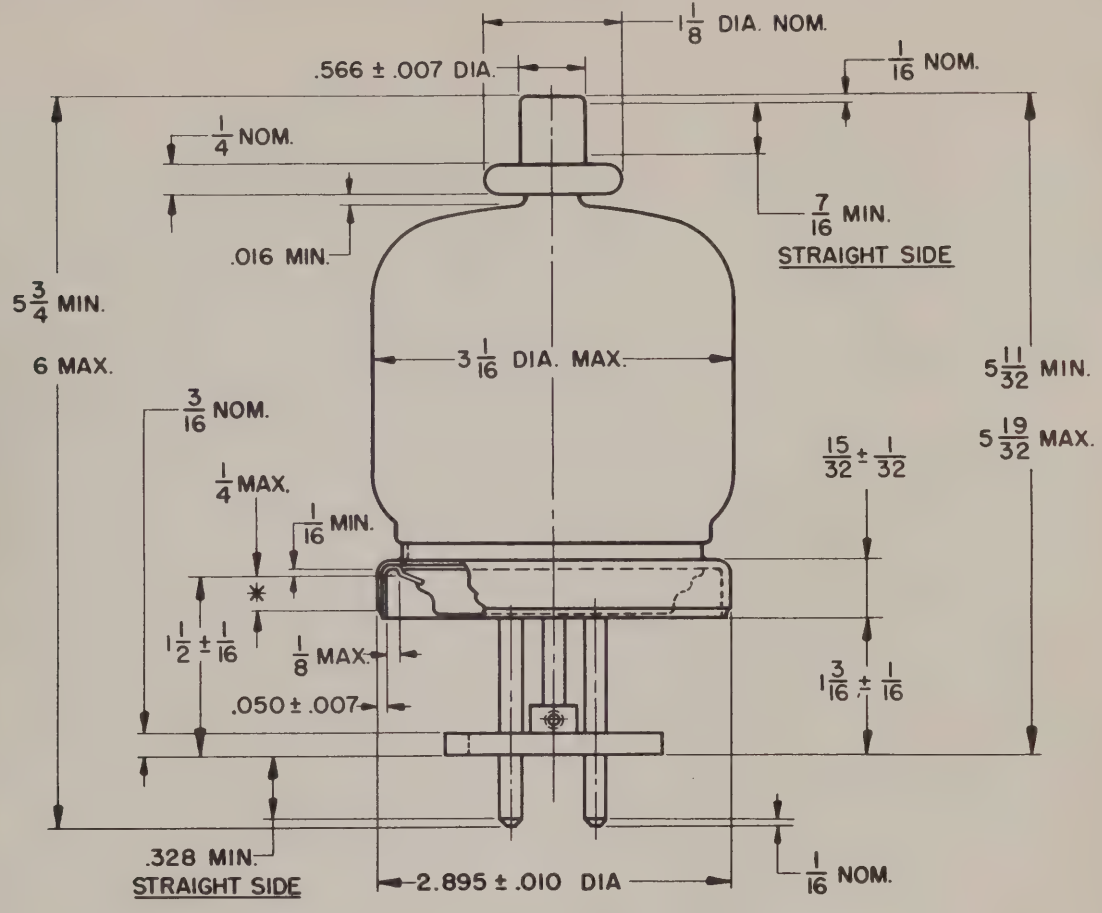
Screen Dissipation—The average power dissipated by the screen of the 4PR60A must not exceed eight watts. A protective series resistance of not less than 20,000 ohms must be inserted in the screen - voltage supply circuit and the screen should be adequately by-passed directly to the cathode by means of a suitable capacitor.

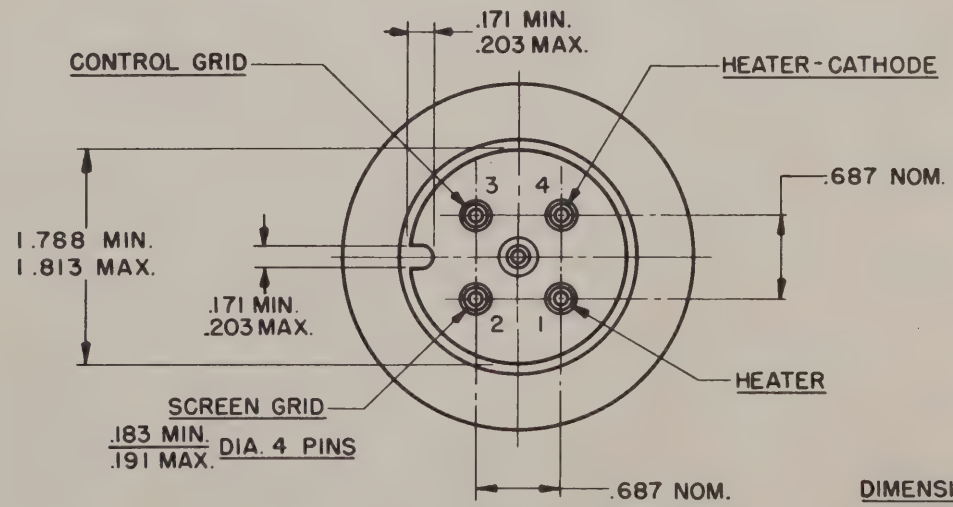
Plate Voltage—The plate-supply voltage for the 4PR60A should not exceed 20 kilovolts. In circuits employing inductive loading, the peak instantaneous plate voltage should not exceed 25 kilovolts.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4PR60A should not be allowed to exceed 60 watts. Plate dissipation in excess of maximum rating is permissible for short periods of time, such as during adjustment procedures. The 4PR60A should not be operated without a heat dissipating plate connector such as the recommended Eimac HR-8.



▶ Indicates change from sheet dated 8-15-52.



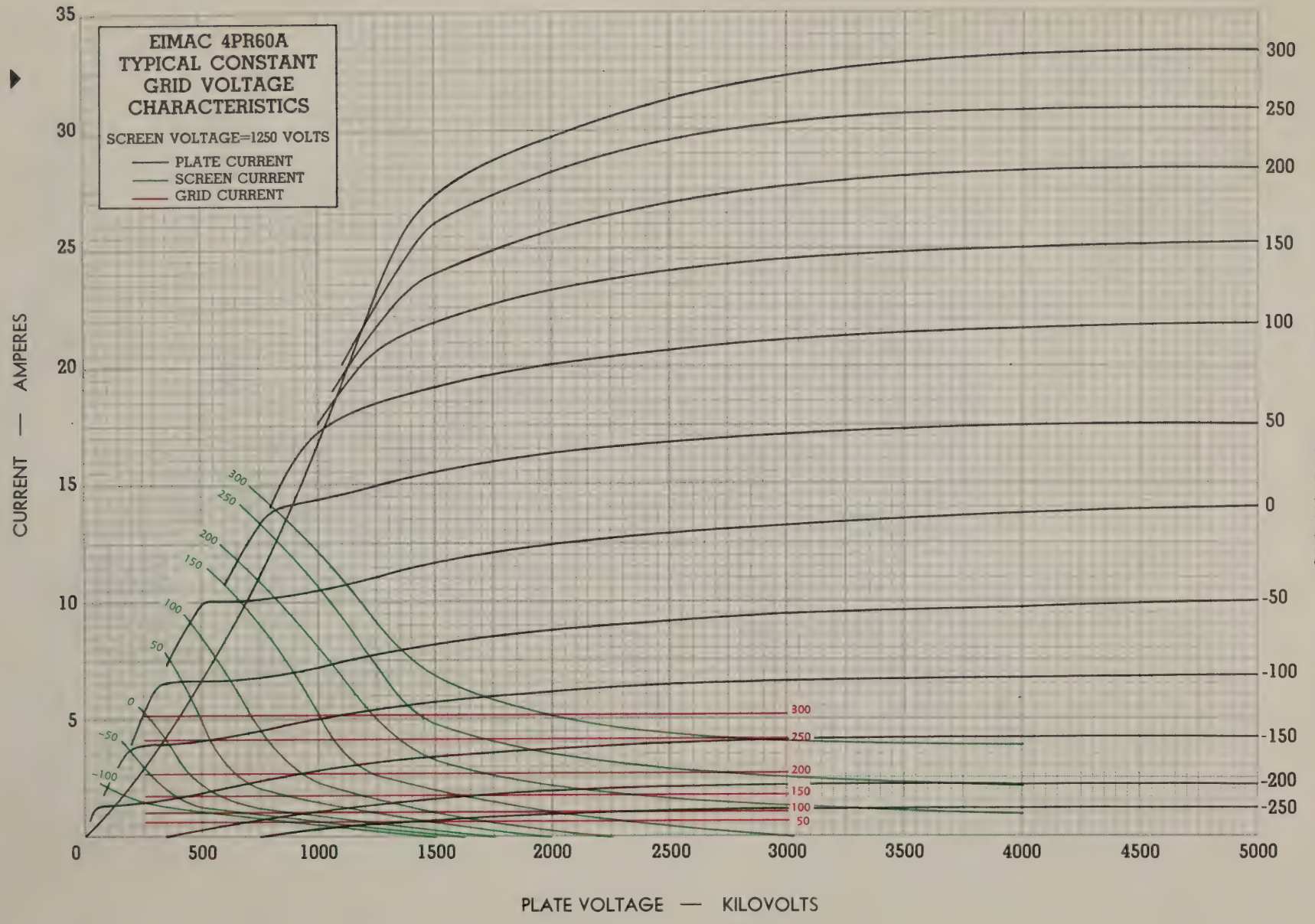


BOTTOM VIEW

DIMENSIONS IN INCHES

THE BASE SHALL BE CAPABLE OF ENTERING A GAUGE 1/4" THICK HAVING 4 HOLES WHOSE DIA'S ARE .214" AND WHICH ARE LOCATED ON 11/16" CENTERS AND A CENTER HOLE OF .250" DIA.

*CYLINDRICAL SURFACE AVAILABLE FOR CLAMPING MUST NOT BE DEFORMED BY ACTION OF CLAMPS



Eimac 4PR60A

▶ Indicates change from sheet dated 8-15-52.

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EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

TENTATIVE DATA

4W300B

RADIAL-BEAM POWER TETRODE



The Eimac 4W300B is a compact radial-beam tetrode with a maximum plate-dissipation rating of 300 watts and a maximum input-power rating of 500 watts. Electrically identical to the Eimac 4X250B, it is intended for use where water cooling is preferred or where reserve anode dissipation is desired.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	-	30	60	seconds
Heater: Voltage	-	-	6.0	volts
Current	-	2.3	2.9	amperes
Amplification Factor (Grid-Screen)		5.2		
Transconductance (I_b=200 ma.)		12,000		umhos
Frequency for Maximum Ratings			500	mc

Interelectrode Capacitances, Grounded Cathode:*	Min.	Nom.	Max.	
Input	14.2		17.2	uuf
Output	4.0		5.0	uuf
Feedback	-	-	0.06	uuf
Interelectrode Capacitances, Grounded Grid and Screen:*				
Input	-	13.0		uuf
Output	4.0		5.0	uuf
Feedback	-	0.01		uuf

MECHANICAL

Base	9-pin, special
Maximum Operating Temperatures:	
Glass-to-Metal Seals	175° C
Ceramic-to-Metal Seals	250° C
Cooling (See following page)	Water and forced air
Recommended Socket	Eimac SK-600 Series
Operating Position	Vertical, base down or up

MAXIMUM RATINGS

	Class-C Plate Mod	Class-C Teleg or FM	Class-AB Audio or SSB	
D-C PLATE VOLTAGE	1500	2000	2000	MAX. VOLTS
D-C SCREEN VOLTAGE	300	300	400	MAX. VOLTS
D-C GRID VOLTAGE	-250	-250	...	MAX. VOLTS
D-C PLATE CURRENT	200	250	250	MAX. MA
PLATE DISSIPATION	200	300	300	MAX. WATTS
SCREEN DISSIPATION	12	12	12	MAX. WATTS
GRID DISSIPATION	2	2	2	MAX. WATTS

*In Shielded Fixture.

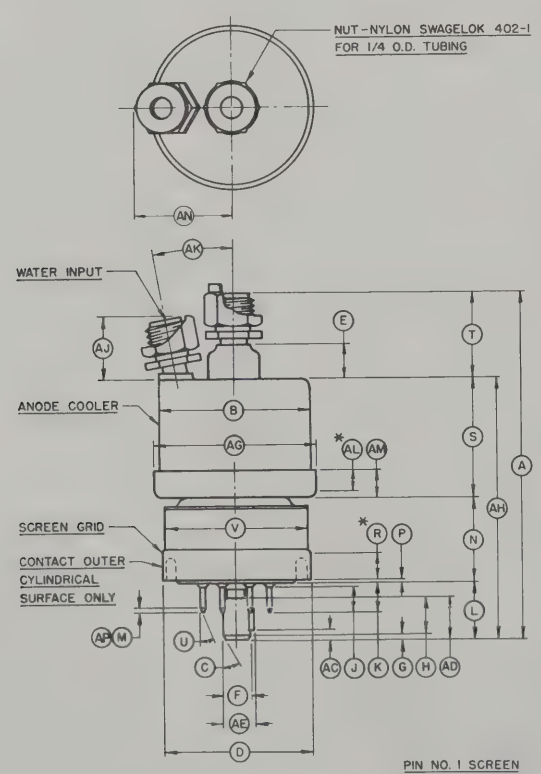
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TYPICAL OPERATION	D-C Plate Voltage (Volts)	Power Input (Watts)	Driving Power (Watts)	Power Output (Watts)
Class-C Amplifier				
Telegraphy or FM	2000	500	3	390
Plate Modulated	1500	300	2	235
Class-AB$_1$ Amplifier				
Audio (Two tubes)	2000	1000	0	600
SSB (One tube)	2000	500	0	300

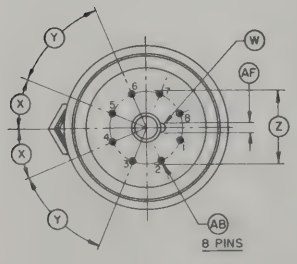
COOLING

The water-cooled anode requires a minimum of 1/16 gallon of cooling water per minute for the rated plate dissipation of 300 watts. The outlet-water temperature should not exceed 70° C and the system pressure should not exceed 50 pounds per square inch. The pressure drop across the cooler with the specified flow is approximately 0.02 pounds per square inch.

The glass-to-metal seals and the ceramic-to-metal seals must be cooled by forced air. At frequencies below 30 megacycles and when one of the recommended sockets is used, a flow rate of 1.0 CFM is sufficient. As the operating frequency is increased, the air-flow rate must be increased. At 500 megacycles a minimum of 3.8 CFM is required. In all cases, seal temperatures are the criteria which determine cooling effectiveness.



DIMENSION DATA			
REF.	NOM.	MIN.	MAX.
A			3.407
B		1.450	1.490
C	30°		
D		1.417	1.433
E	.244		
F		.255	.265
G	.031		
H		.360	
J		.187	
K			.250
L		.514	.554
M	.035		
N		.750	.810
P	.020		
R		.187	
S		1.106	1.186
T		.797	.857
U	22.5°		
V			1.406
W			.043R
X	22.5°		
Y	45°		
Z		.680	.694
AB		.045	.053
AC		.068	.108
AD			.456
AE		.298	.308
AF		.078	.086
AG			1.562
AH			2.550
AJ	.670		
AK	10°		
AL		.156	
AM	.250		
AN			1.063
AP		.005R ALT. TO M & U	



PIN NO. 1 SCREEN
PIN NO. 2 CATHODE
PIN NO. 3 HEATER
PIN NO. 4 CATHODE
PIN NO. 5 I.C. (DO NOT USE FOR EXTERNAL CONN.)
PIN NO. 6 CATHODE
PIN NO. 7 HEATER
PIN NO. 8 CATHODE
CENTER PIN - CONTROL GRID

NOTES:
1. DIMENSIONS IN INCHES.
2. (*) LENGTH AVAILABLE FOR CONTACT.

Printed in U.S.A. 82587

Tentative Data

Eimac

4W20,000A
ADDENDUM

IMPORTANT ADDENDUM
To Eimac 4W20,000A Data Sheet
Dated 2-27-54

Recent improvements in cathode design have enabled Eimac to use a more efficient cathode in the 4W20,000A and 3W10,000A3 resulting in a reduction in the power required for cathode heating. This reduces the normal power for CW operation from 3000 watts to 2500 watts.

Also, in order to better advise the users of these tubes, the following is issued as a supplement to the 4W20,000A data sheet and is equally applicable to the 3W10,000A3. Paragraph three of the section on cathode heating of the 4W20,000A data sheet should be deleted and the following paragraph substituted:

"For maximum tube life the filament voltage, as measured directly at the filament terminals, must be reduced after the cathode has reached operating temperature. The proper operating voltage value for a given cathode bombardment power may be found in the table below. The filament voltage should remain at the 10.0 volt value until the cathode has reached full operating temperature, an interval of approximately thirty seconds. The filament voltage should be maintained to within 5% of the proper operating value and the cathode bombardment power should be held within plus or minus 100 watts of the recommended value.

Cathode Bombardment Power	2000	2250	2500	2750	3000
Filament Voltage	6.0	5.2	4.3	3.2	2.0

A cathode bombardment power of 2500 watts is normal for average CW conditions. In applications requiring values of cathode currents in excess of 150 amperes the cathode bombardment power may be increased to a value between 2500 and 3000 watts as required."

Note: This sheet should be inserted in your Eimac catalog immediately preceeding the 4W20,000A data sheet.

EITEL-McCULLOUGH, INC.
San Bruno, California

1-81905

TENTATIVE DATA

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4W20,000A

RADIAL-BEAM POWER TETRODE

The Eimac 4W20,000A is a high-power, water-cooled transmitting tetrode having a maximum plate dissipation rating of 20 kilowatts. This tube will operate efficiently as a power-amplifier at frequencies up to 250 Mc. A single 4W20,000A operating as a television visual r-f amplifier will deliver a synchronizing power output of 26 kilowatts at 216 Mc., with a 5-Mc. bandwidth.

The coaxial terminal arrangement of the tube is ideally suited for use in cavity circuits. The cathode is a unipotential thoriated tungsten cylinder of rugged construction, heated by electron bombardment.



GENERAL CHARACTERISTICS

ELECTRICAL

Cathode:	Unipotential, thoriated tungsten. Heated by electron bombardment.	
▶	D-C Voltage (Approx.)	1400 volts
▶	D-C Current (Approx.)	1.8 amperes
Filament:	Thoriated Tungsten, Helical	
	Voltage	10 volts
	Current (without cathode bombardment)	30 amperes
	Current (with cathode bombardment)	25 amperes
	Maximum allowable starting current	50 amperes
Direct Interelectrode Capacitances (Average)		
	Grid-Plate	0.5 $\mu\mu$f
	Input	125 $\mu\mu$f
	Output	23 $\mu\mu$f
Screen-Grid Amplification Factor (Average)		5.5
Transconductance (I_b=6.6 A., E_b=3.0 kV., E_{c2}=1200 V.)		75,000 μmhos

MECHANICAL

Base	Special, Concentric
Mounting Position	Vertical, base down or up
Cooling	Water and Forced Air
Maximum Over-all Dimensions	
Length	15.2 inches
Diameter	5.0 inches
Net Weight	7.6 pounds
Shipping Weight	40 pounds

RADIO FREQUENCY POWER AMPLIFIER MAXIMUM RATINGS (per tube)

D-C PLATE VOLTAGE	8 MAX. KV
D-C PLATE CURRENT	15 MAX. AMP
PLATE DISSIPATION	20 MAX. KW
SCREEN DISSIPATION	200 MAX. WATTS
GRID DISSIPATION	60 MAX. WATTS

TYPICAL OPERATION

Class-C Telegraphy or FM Telephony (Per tube—220 Mc.)

D-C Plate Voltage	5000	6000	7000	volts
D-C Screen Voltage	1200	1200	1200	volts
D-C Grid Voltage	—350	—370	—400	volts
D-C Plate Current	3.6	3.6	3.4	amps
D-C Screen Current (approx.)*	167	167	167	ma
D-C Grid Current (approx.)	50	50	50	ma
Peak R-F Input Voltage	455	475	505	volts
Driving Power (approx.)*	750	780	830	watts
Screen Dissipation	200	200	200	watts
Plate Power Input	18	21.6	23.8	kw
Plate Dissipation	7.0	8.6	8.0	kw
Useful Power Output	9.2	11.5	13.0	kw

*The performance figures listed above are obtained by calculation from the characteristic tube curves and confirmed by direct tests. The driving power and output power allow for losses associated with practical resonant circuits.

TYPICAL OPERATION

Class-B Linear Amplifier—Television Visual Service
(Per tube, 5-Mc. Bandwidth up to 216 Mc.)

Peak Synchronizing Level		
Load Impedance	650	ohms
Effective Length of Plate Line	¼	wave
D-C Plate Voltage	7000	volts
D-C Screen Voltage	1200	volts
D-C Control Grid Voltage	—150	volts
D-C Plate Current	6.0	amps
D-C Screen Current (approx.)	230	ma
D-C Control Grid Current (approx.)	90	ma
Peak R-F Grid Input Voltage	280	volts
Driving Power (approx.)	500	watts
Plate Power Input	42	kw
Plate Dissipation	16	kw
Useful Plate Power Output	26	kw
Black Level		
D-C Plate Current	4.5	amps
D-C Screen Current	100	ma
D-C Control Grid Current (approx.)	45	ma
Peak R-F Grid Input Voltage	220	volts
Driving Power (approx.)	300	watts
Plate Power Input	32	kw
Plate Dissipation	16.5	kw
Useful Power Output	15.5	kw

These 216 Mc. typical performance figures were obtained by direct measurement in test equipment. The output power is useful power measured in a load circuit. The driving power is that taken by the tube and a practical resonant grid circuit. These figures are subject to variation and in many cases, with further refinement and improved techniques, better performance might be obtained.

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TENTATIVE DATA

▶ Indicates change from sheet dared 3-1-53

Note: Typical operation data are based on conditions of adjusting to a specificied plate current, maintaining fixed conditions of grid bias, screen voltage, suppressor voltage and r-f grid voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid, screen and suppressor currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

APPLICATION

Mounting—The 4W20,000A must be mounted vertically. Base-down or base-up mounting is optional.

The co-axial contact surfaces provided for connection to the filament, cathode, grid, screen, and anode are of successively larger diameters to facilitate removal and replacement of tubes.

Cavity circuits may be designed around the dimensions shown in the outline drawing. At very high frequencies the points of contact between the tube and the external circuit will be required to carry high values of charging current. It is, therefore, essential that the contactors make firm and uniform contact between the terminal surfaces of the tube and the external circuit. Particular care should be taken that the contactors are not inadvertently forced out of shape, and that all contact surfaces are maintained free from dust or other foreign matter which would prevent uniform electrical connection. At VHF, poor contact by one finger of a multi-finger collet can result in local overheating which may damage the tube seals.

Although contact fingers or slotted collets are often made an integral part of cavity circuits, there is some advantage to reversing the plan by providing contact-finger assemblies which are designed to be clamped firmly to the terminal surfaces of the tube itself and to make sliding contact with the cavity as the tube is inserted. This arrangement facilitates replacement of worn or damaged contactors and tends to remove incidental local heating from the vicinity of the tube seals. Tubes held in reserve for emergency replacement may be fitted with contact-finger assemblies and water-line extensions to minimize lost time in making changes.

▶ **Cathode Heating Power**—The cathode of the 4W20,000A is a unipotential, thoriated tungsten cylinder, heated by electron bombardment of its inner surface. Bombardment is obtained by using the cylindrical cathode as the anode of a diode. A helical filament is mounted on the axis of the cathode cylinder to supply the bombarding electrons. A d-c potential of approximately 1400 volts is applied between the filament and the cathode cylinder, and the recommended cathode heating power of 2500 watts is obtained with approximately 1.8 amperes.

The inner filament is designed to operate under space-charge limited conditions so that the cathode temperature may be varied by changing the voltage applied between the inner filament and the cathode cylinder.

For maximum tube life the filament voltage, as measured directly at the filament terminals, and the cathode power should be held at their rated values. Variations in filament voltage should be held within the range of 9.5 to 10.5 volts, cathode power within the range of 2250 to 2750 watts.

Further increases in cathode efficiency will result in a decrease in the cathode bombardment power requirements. The cathode bombardment power supply should, therefore, be capable of providing a minimum of approximately 2000 watts.

Caution: It must be kept in mind that the filament is at a potential of 1400 volts d-c with respect to ground. The filament transformer and voltmeter must be adequately insulated for this voltage.

▶ **Grid Voltage Regulation**—The practice of designing grid voltage supplies to maintain adequate regulation under conditions of varying grid current is particularly desirable with the 4W20,000A. Because the cathode of the 4W20,000A is a complete cylinder, grid temperatures run higher than usual. For this reason, even with no excitation, control grid current reversal might conceivably be several milliamperes and safe design should allow for possible peaks on the order of 100 milliamperes.

▶ **Anode Cooling**—The water-cooled anode requires 6 gallons per minute of cooling water for the rated 20 kilowatts of plate dissipation. This corresponds to a pressure drop of 1 pound per square inch across the water jacket. The inlet water pressure must not exceed a maximum of 50 pounds per square inch.

The outlet water temperature must not exceed a maximum of 70°C under any conditions.

▶ **Seal Cooling**—The grid and screen tube contact surfaces and adjacent glass and ceramic must be cooled by high-velocity air which may be accomplished by means of ring manifolds. The quantity, velocity and direction of air must be adjusted to limit the maximum seal temperatures to 150°C.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

▶ Indicates change from sheet dated 3-1-53

The cathode and filament stem also require forced-air cooling in sufficient quantity so that the region on the cathode terminal opposite the glass of the grid terminal seal does not exceed a maximum of 150°C. The major portion of this air must be guided along the surface of the terminal sleeve. The remaining air flows through the nine holes inside the terminal sleeve, cools the filament stem and vents through the three holes in the tube base enclosed by the outer filament spring collet connection.

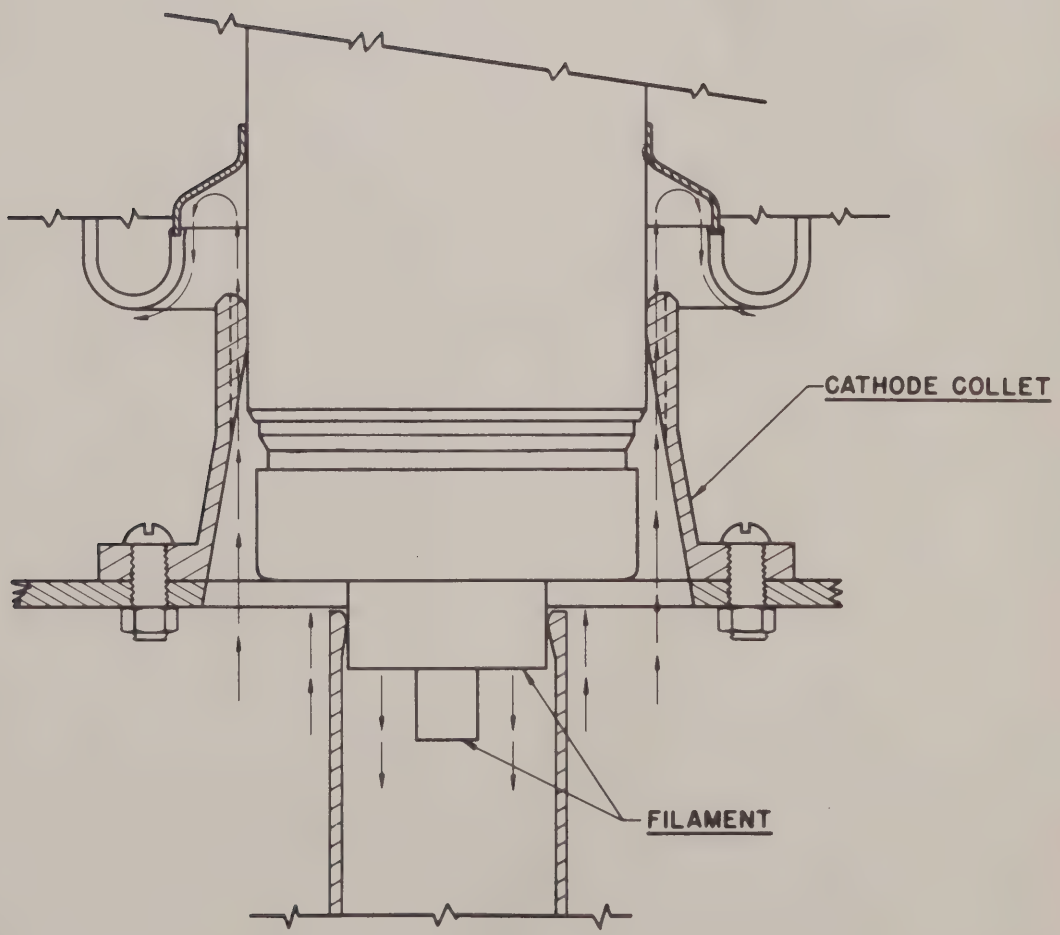
By employing a cathode collet such as is shown in the accompanying drawings, the recommended cooling requirements will be fulfilled with an air flow of 25 cubic feet per minute at a static manifold pressure of 2 inches of water.

Tube temperatures may be measured with the aid of "Tempilaq", a temperature-sensitive lacquer manufactured by the Tempil Corporation, 11 West 25th St., New York 10, N. Y.

Air and water flow must be started before filament and cathode power are applied and maintained for at least two minutes after the filament and cathode power have been removed.

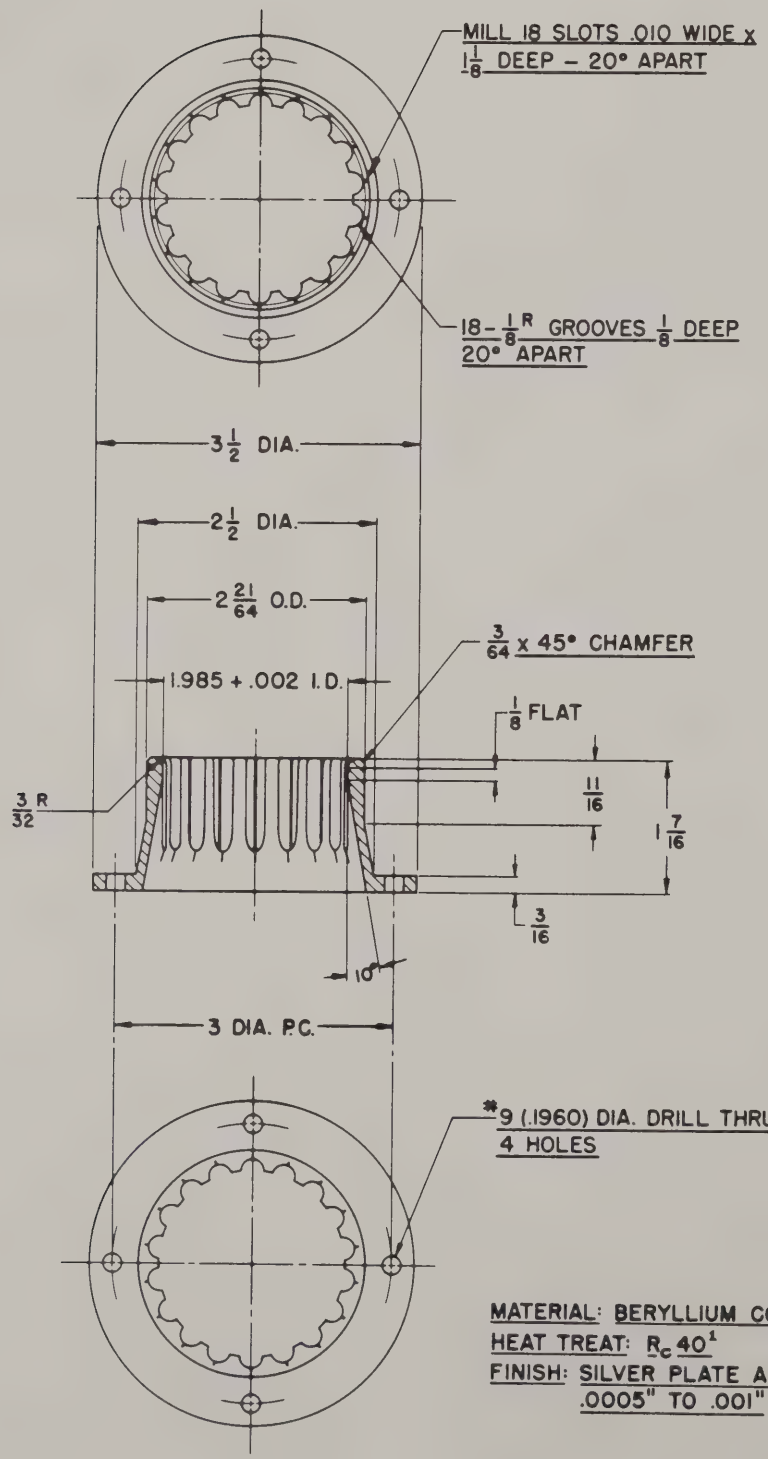
4W20,000A/3W10,000A3

SUGGESTED STEM AIR COOLING



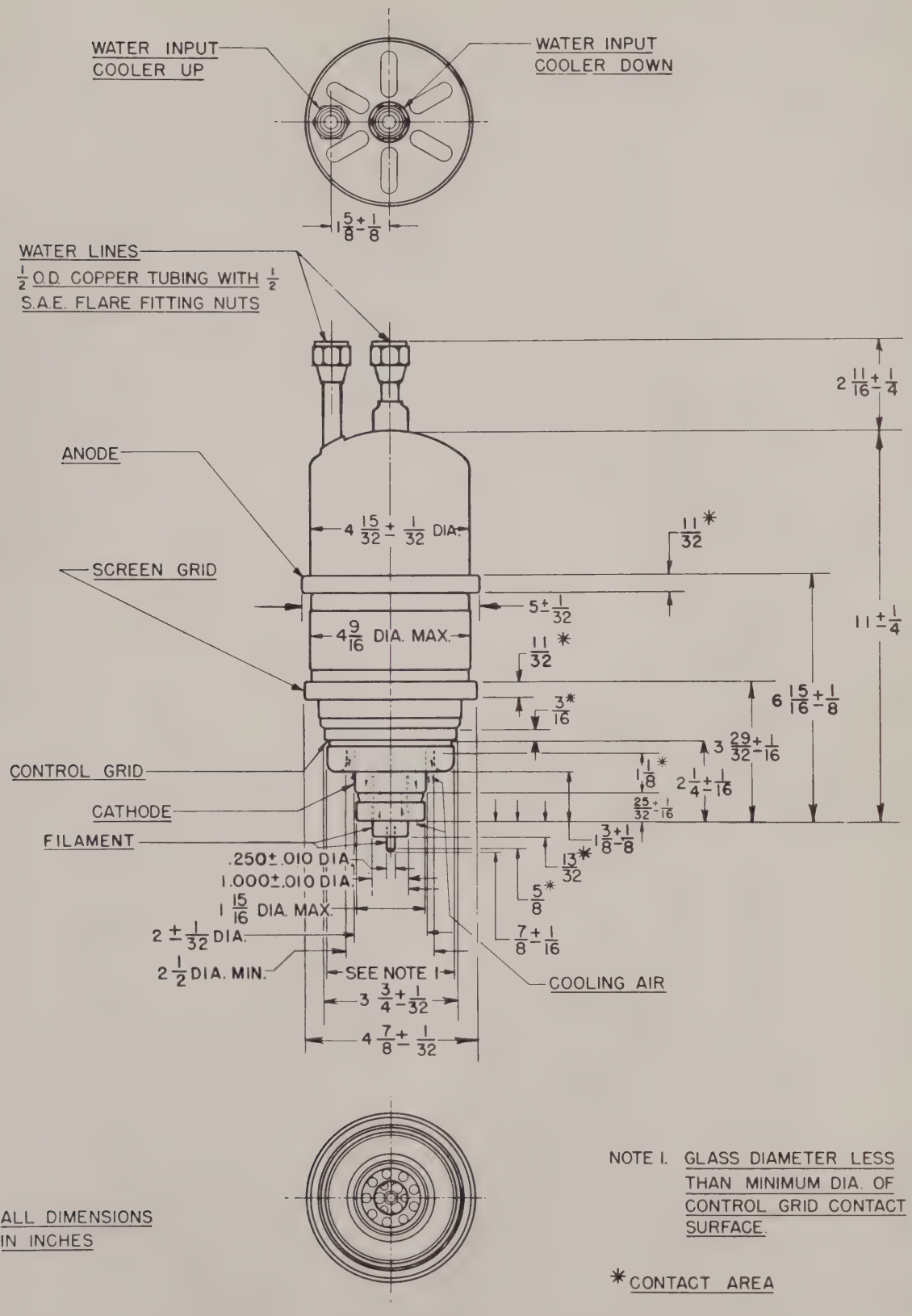
4W20,000A/3W10,000A3

CATHODE COLLET



MATERIAL: BERYLLIUM COPPER
HEAT TREAT: R_C 40[1]
FINISH: SILVER PLATE APPROX. .0005" TO .001"

[1] 385°C FOR APPROX. 5–6 HRS. IN NON-REDUCING ATMOSPHERE



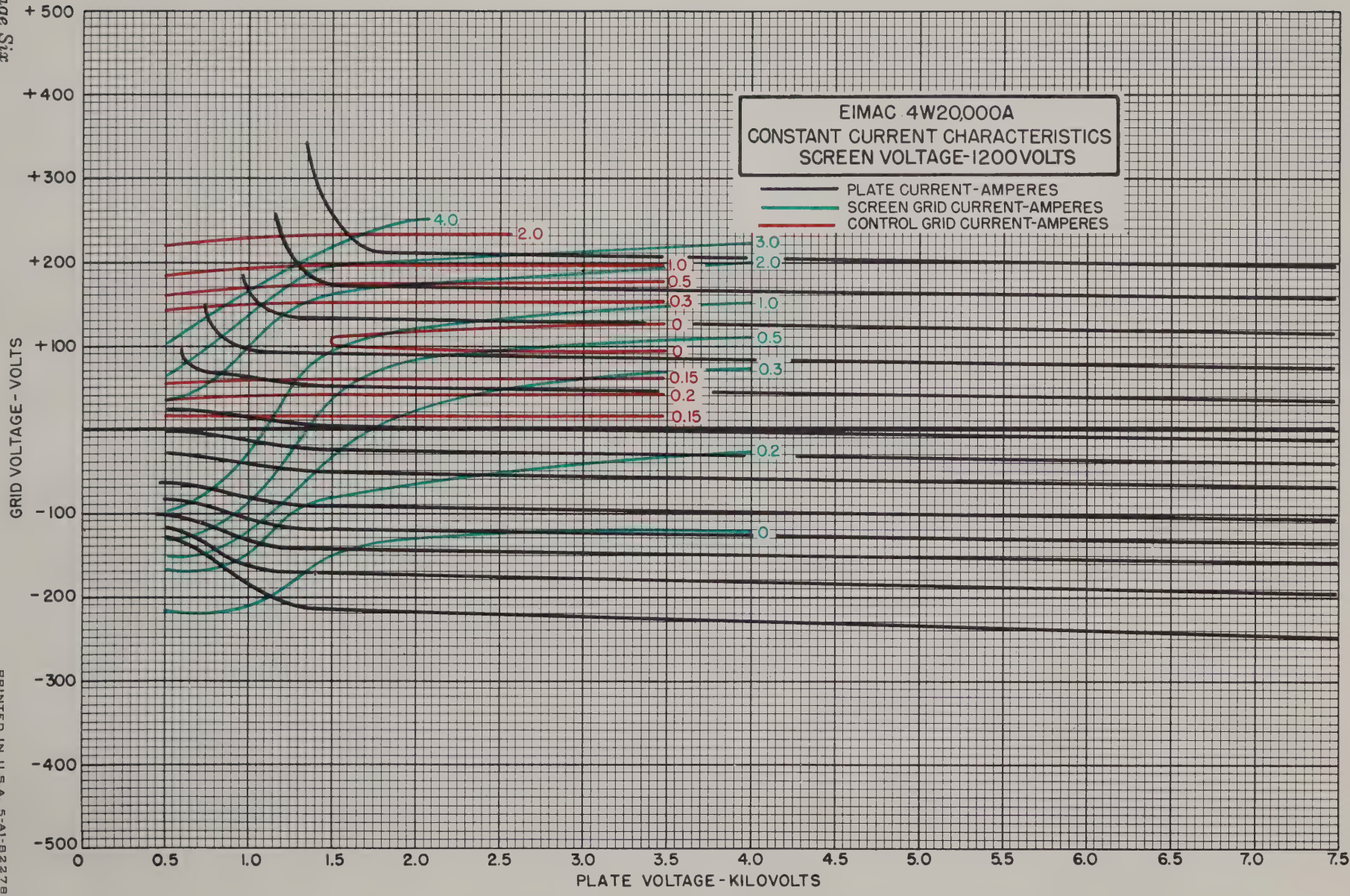
BOTTOM VIEW

ALL DIMENSIONS IN INCHES

NOTE 1. GLASS DIAMETER LESS THAN MINIMUM DIA. OF CONTROL GRID CONTACT SURFACE.

* CONTACT AREA

▶ Indicates change from sheet dated 3-1-53



Eimac 4W20,000A

PRINTED IN U.S.A. 5-A1-B2278

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS • CALIFORNIA

4X150A
4X150D
RADIAL-BEAM POWER TETRODE



The Eimac 4X150A and 4X150D tetrodes are compact power tubes intended for use as amplifiers, oscillators, or frequency multipliers at frequencies up to 500 megacycles. The 4X150A is designed to operate with a heater voltage of 6.0 volts, whereas the 4X150D is designed for operation at a heater potential of 26.5 volts. Otherwise, the two tube types have identical characteristics.

Recent improvements in the 4X150A and 4X150D have allowed an increase in maximum plate-dissipation ratings for all classes of service. Further, the maximum plate-voltage rating has been raised for operation at frequencies below 150 megacycles.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		seconds
Cathode-to-Heater Potential			±150	volts
Heater: Voltage 4X150A		6.0		
Current 4X150A	2.3		3.8	amperes
Voltage 4X150D		26.5		volts
Current 4X150D	0.5		0.62	ampere
Amplification Factor (Grid-to-Screen)	4		6	

Direct Interelectrode Capacitances, Grounded Cathode:*	Min.	Max.
Input	14.5	17.0 uuf
Output	4.0	4.3 uuf
Feedback		0.05 uuf
Frequency for Maximum Ratings		150 mc
Highest Useful Frequency		500 mc

*In Shielded Fixture

MECHANICAL

Base	Special 9-pin
Maximum Operating Temperatures:	
Base Seals	175° C
Anode Seal	200° C
Anode Core	250° C
Recommended Socket	Eimac SK-600 series
Operating Position	Any
Maximum Dimensions:	
Height	2.404 inches
Diameter	1.640 inches
Cooling	Forced Air
Net Weight	4 ounces
Shipping Weight (Approximate)	1.6 pounds

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

(Effective 6/15/60) Copyright 1960 by Eitel-McCullough, Inc.

TYPICAL OPERATION

	Frequencies up to 150 Mc.				500 Mc.†
D-C Plate Voltage	500	1000	1500	2000	1250 volts
D-C Screen Voltage	250	250	250	250	250 volts
D-C Grid Voltage	—90	—90	—90	—90	—80 volts
D-C Plate Current	250	250	250	250	200 ma
D-C Screen Current*	45	38	21	19	7 ma
D-C Grid Current*	35	31	28	26	10 ma
Peak R-F Grid Voltage*	114	114	112	112	.... volts
Driving Power	4.0	3.5	3.2	2.9	10 watts
Plate Input Power	125	250	375	500	250 watts
Plate Output Power	70	190	280	390	140 watts

*Approximate values.

†The typical performance figures for 500-megacycle operation were obtained by direct measurement in operating equipment. The output power is *useful* output power measured at the load. The driving power is the total power taken by the tube and a practical resonant circuit.

NOTE: Heater voltage was reduced to 5.5 volts and 24.3 volts for the 4X150A and 4X150D respectively.

Indicates change from sheet dated 5/10/54

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	1600 MAX. VOLTS
150 to 500 megacycles	1000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 megacycles)

D-C Plate Voltage	500	1000	1600 volts
D-C Screen Voltage	250	250	250 volts
D-C Grid Voltage	—150	—150	—150 volts
D-C Plate Current	200	200	200 ma
D-C Screen Current*	25	20	18 ma
D-C Grid Current*	23	21	21 ma
Peak R-F Grid Input Voltage*	173	172	172 volts
Driving Power	4.0	3.6	3.6 watts
Plate Input Power	100	200	320 watts
Plate Output Power	47	140	250 watts

*Approximate values.

AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB_1

MAXIMUM RATINGS (per tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Sinusoidal wave, two tubes unless noted)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	200	200	200 ma
Max-Signal D-C Plate Current	500	500	500 ma
Max-Signal D-C Screen Current	20	16	10 ma
Effective Load, Plate to Plate	3500	6200	9500 ohms
Peak A-F Grid Input Voltage (per tube)*	50	50	50 volts
Driving Power	0	0	0 watts
Max-Signal Plate Output Power	240	430	600 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER

Class-AB_1 (Carrier Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 Mc)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Zero-Signal D-C Plate Current	100	100	100 ma
D-C Plate Current	150	150	150 ma
D-C Screen Current*	—3	—4	—4 ma
Peak R-F Grid Voltage*	25	25	25 volts
Plate Output Power	30	50	65 watts

*Approximate values.

[1]Adjust grid bias to obtain listed zero-signal plate current.

RADIO-FREQUENCY LINEAR AMPLIFIER, SSB

Class-AB_1 (Single-Tone Conditions)

MAXIMUM RATINGS

D-C PLATE VOLTAGE:	
Up to 150 megacycles	2000 MAX. VOLTS
150 to 500 megacycles	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 150 megacycles)

D-C Plate Voltage	1000	1500	2000 volts
D-C Screen Voltage	350	350	350 volts
D-C Grid Voltage[1]	—55	—55	—55 volts
Peak R-F Grid Voltage*	50	50	50 volts
Zero-Signal D-C Plate Current	100	100	100 ma
Single-Tone D-C Plate Current	250	250	250 ma
Two-Tone D-C Plate Current	190	190	190 ma
Single Tone D-C Screen Current*	10	8	5 ma
Two-Tone D-C Screen Current*	2	—1	—2 ma
R-F Load Impedance	1750	3100	4750 ohms
Single-Tone Plate Input Power	250	375	500 watts
Single-Tone Plate Output Power	120	215	300 watts

*Approximate values.

[1]Adjust to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made.

In class-C operation, adjustment of the r-f grid drive to obtain listed plate current at the listed grid bias, screen voltage, and plate voltage is assumed. Resultant screen and grid currents will vary from tube to tube, but little change in output power will be noted.

In class-AB_1 linear operation, screen current will also vary from tube to tube but is a useful indicator of relative linearity. In general, less screen current means better linearity, providing other conditions are held constant. The same degree of linearity will be obtained from different tubes if loading and drive are adjusted to give the same plate and screen currents, although output power may vary from tube to tube.

APPLICATION

MECHANICAL

Mounting—The 4X150A and 4X150D may be operated in any position. An Eimac Air-System Socket, SK-600 series, or a socket having equivalent characteristics, is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

Cooling—Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the Eimac SK-600 series and an Eimac SK-606 chimney are used with air flow in the base to anode direction.

	SEA LEVEL		10,000 FEET	
Plate Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (Inches of Water)	Air Flow (CFM)	Pressure Drop (Inches of Water)
200	3.6	.34	5.25	.5
250	4.8	.55	7.00	.8

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters. The blower must be designed to deliver the air at the desired altitude.

At 500 Mc or below, base-cooling air requirements are satisfied automatically when the tube is operated in an Eimac Air-System Socket and the recommended air-flow rates are used. Experience has shown that if reliable long-life operation is to be obtained, the cooling air-flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

Vibration—These tubes are capable of satisfactorily withstanding ordinary shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in automobile and truck mobile installations and similar environments. However, when shock and vibration are expected to exceed approximately 5g units, it is suggested that the Eimac 4CX300A be employed.

ELECTRICAL

Heater—The rated heater voltage for the 4X150A and 4X150D is 6.0 volts and 26.5 volts, respectively, and the voltage should be maintained as closely as practicable. Short-time changes of ± 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within ± 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approximately 300 megacycles, transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, plate current, and driving power. When the tube is driven to maximum input as a "straight-through" class-C amplifier, the heater voltage should be reduced according to the table below:

Frequency, Mc	4X150A	4X150D
300 and lower	6.00 volts	26.5 volts
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode Operation—The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum rated d-c input current is 200 milliamperes for plate-modulated operation and 250 milliamperes for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins, and all four of the corresponding socket terminals should be used to make connection to the external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that rated heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Control-Grid Operation—The maximum rated d-c grid bias voltage is –250 volts and the maximum grid dissipation rating is 2.0 watts. In ordinary audio and radio-frequency amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100-megacycle region, driving-power requirements for amplifiers increase noticeably. At 500 megacycles as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500-megacycle operation of the tubes in a stable "straight-through" amplifier is indicated by grid-current values below approximately 15 milliamperes.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

The maximum permissible grid-circuit resistance per tube is 100,000 ohms.

Screen-Grid Operation—The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated d-c screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the d-c screen voltage.

When signal voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the d-c screen voltage and the peak a-c or r-f signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes, or an electron tube *shunt* regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube *series* regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation or plate-modulated r-f amplifiers using the 4X150A or 4X150D.

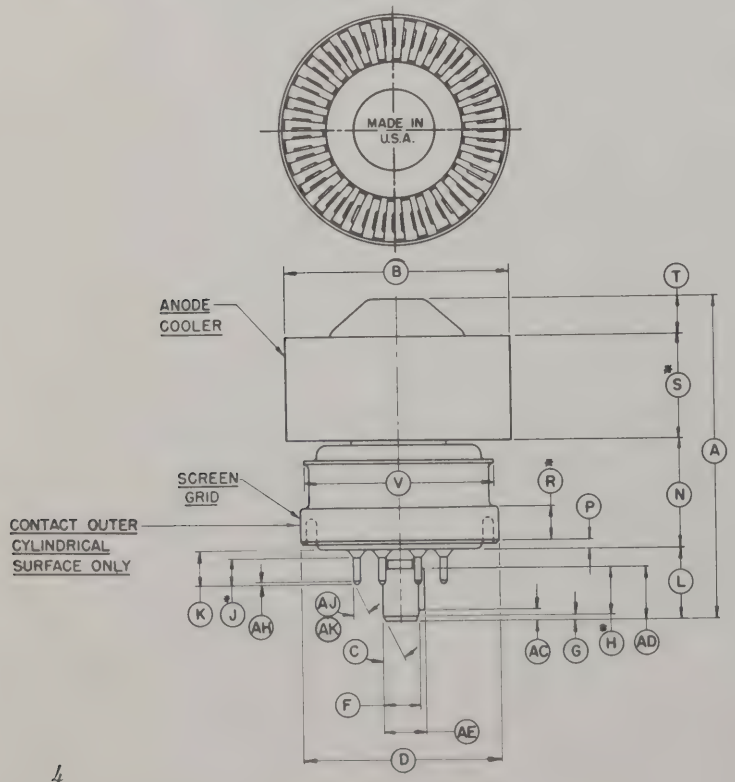
Plate Operation—The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

Multiple Operation—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustment of bias or screen voltage to equalize the inputs.

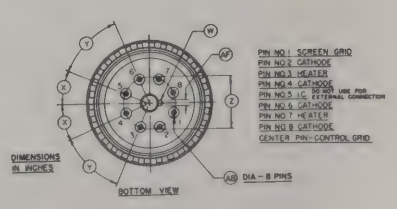
Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

UHF Operation—The 4X150A and 4X150D are suitable for use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

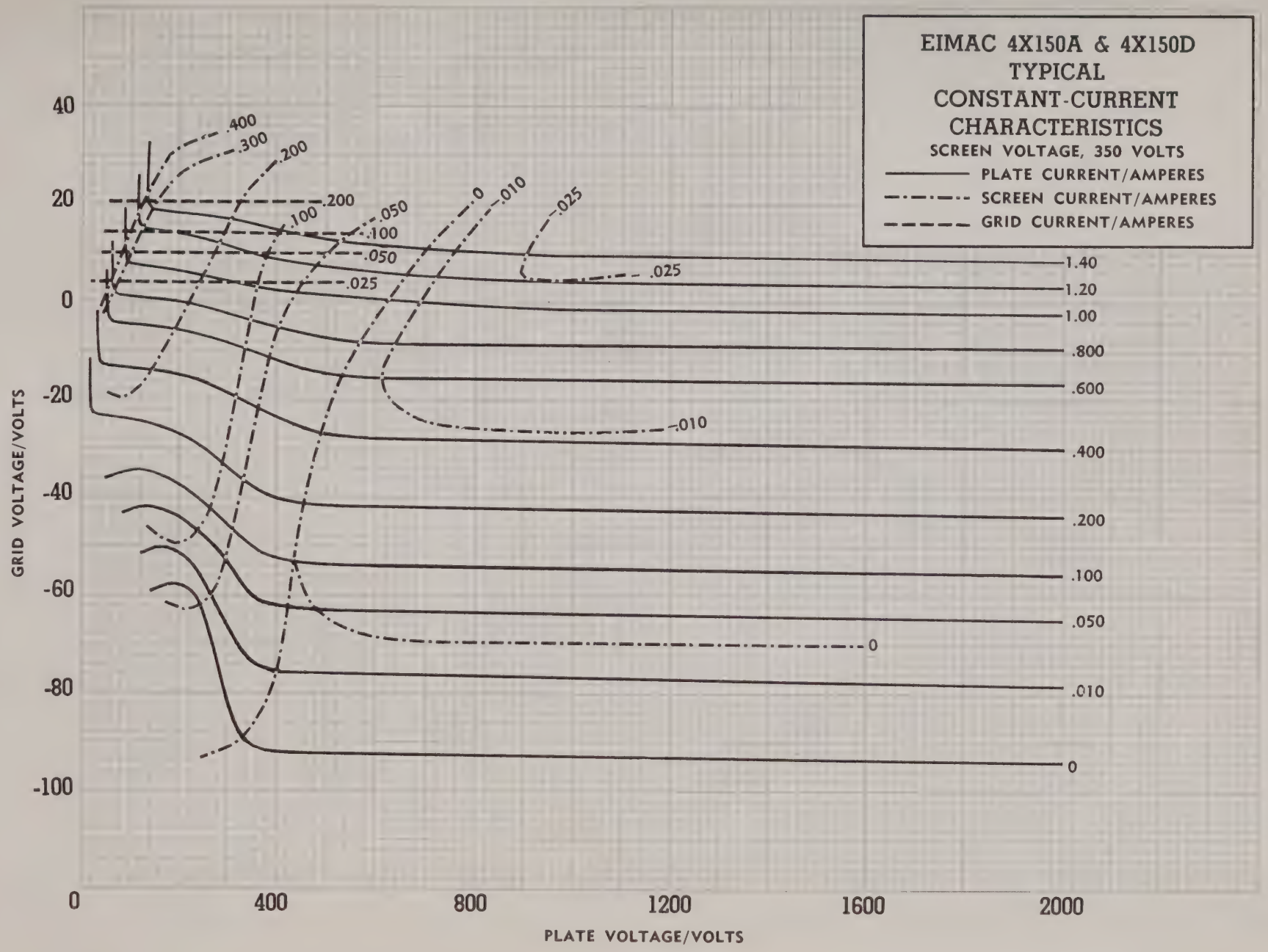
Special Applications—If it is desired to operate these tubes under conditions widely different from those given here, write to the Application Engineering Department, Eitel-McCullough, Inc., San Carlos, California, for information and recommendations.

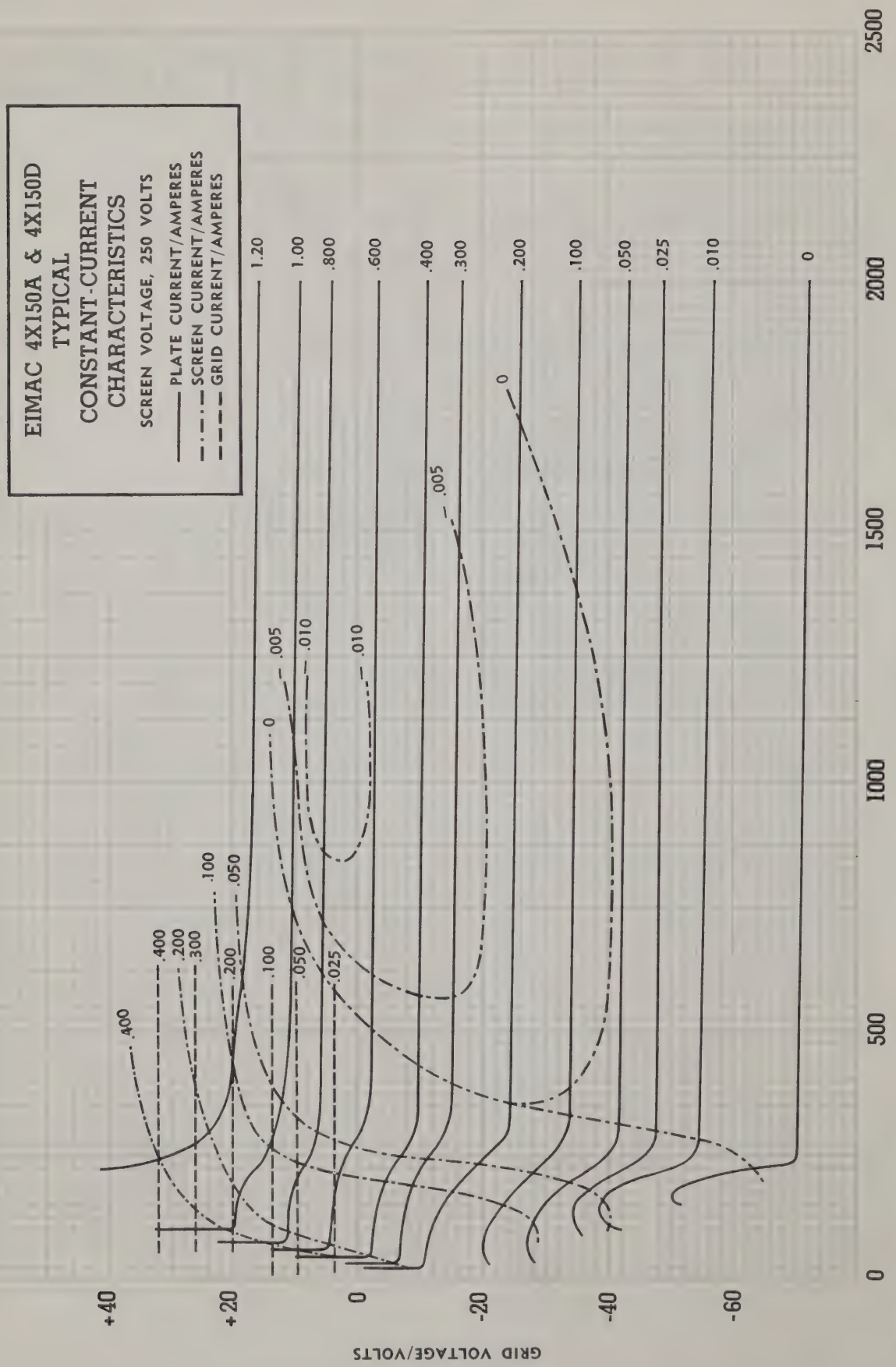


DIMENSION DATA		
REF	MIN.	MAX.
A		2.468
B	1.610	1.640
C	30°	
D	1.417	1.433
F	.255	.265
G	1/32	
H	.360	
J	.187	
K		.250
L	.514	.554
N	.750	.810
P	.080	
R	.187	
S	.710	.750
T		.312
V		1.406
W		.043R
X	22½°	
Y	45°	
Z	.680	.694
AB	.045	.053
AC	.068	.108
AD		.456
AE	.298	.308
AF	.078	.086
AH	.035	
AJ	22½°	
AK	.005R	



* CONTACT SURFACE


EIMAC 4X150A & 4X150D
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT/AMPERES
SCREEN CURRENT/AMPERES
GRID CURRENT/AMPERES
GRID VOLTAGE/VOLTS
PLATE VOLTAGE/VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.400
.300
.200
.200
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Printed in U.S.A. 637

Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

4X150G
RADIAL-BEAM POWER TETRODE

The Eimac 4X150G is an extremely compact external-anode tetrode intended for use as a radio-frequency amplifier, frequency multiplier, or oscillator at frequencies well into the UHF region or as an amplifier in any service requiring a high-gain tube capable of delivering high power-output at low plate-voltage. The combination of a high ratio of transductance to capacitance and a plate dissipation capability of 150 watts make the tube an excellent wide-band amplifier for video applications.

The cathode, grid and screen electrodes are mounted on conical and cylindrical supports giving a minimum of circuit discontinuities and lead inductance. The rugged cylindrical terminals, progressively larger in size, allow the tube to be inserted in coaxial line cavities. The screen support and terminal provide maximum isolation between the grid-cathode terminals and the plate circuit.

In amplifier service at 500 megacycles, output power of 140 watts per tube, with a stage power-gain of 14, can be obtained. At 1000 megacycles an output power of 50 watts per tube is obtained with a power-gain of five.



GENERAL CHARACTERISTICS

ELECTRICAL		
Cathode: Coated Unipotential		
Heater Voltage	2.5	volts
Heater Current	6.25	amperes
Minimum Heating Time	45	seconds
Screen-Grid Amplification Factor (Average)	5.0	
Direct Interelectrode Capacitances (Average)	Grounded Grid	Grounded Cathode
Feedback (without shielding)	less than 0.005	0.035 uufd
Input	17.	27 uufd
Output	4.5	4.5 uufd
Transconductance (I_b=250 ma., E_b=500v., E_{c2}=250 V.)	12,000 umhos	
MECHANICAL		
Cooling	Forced Air	
Mounting position	Any	
Maximum Over-all Dimensions		
Length	2¾	inches
Diameter	1.635	inches
Maximum Seated Height	1-27/32	inches
Net Weight	6	ounces
Shipping Weight (Average)	1.6	pounds

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	150 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 165 Mc., per tube)

D-C Plate Voltage	600	750	1000	1250	volts
D-C Screen Voltage	250	250	250	250	volts
D-C Grid Voltage	—75	—80	—80	—90	volts
D-C Plate Current	200	200	200	200	ma
D-C Screen Current	37	37	30	20	ma
D-C Grid Current	10	10	10	10	ma
Peak R-F Grid Voltage (approx.)	90	95	95	105	volts
Driving Power	0.7	0.7	0.7	0.8	watts
Plate Power Input	120	150	200	250	watts
Plate Power Output	85	110	150	195	watts

The performance figures for frequencies up to 165 Mc. are obtained by calculation from the tube characteristic curves and confirmed by direct tests. The driving power includes only power taken by the tube grid and the bias circuit. The driving power and output power do not allow for losses in the associated resonant circuits.

TYPICAL OPERATION (Single tube, 500 Mc., coaxial cavity)

D-C Plate Voltage	600	800	1000	1250	volts
D-C Screen Voltage	250	250	250	250	volts
D-C Grid Voltage	—80	—80	—80	—80	volts
D-C Plate Current	200	200	200	200	ma
D-C Screen Current	7	7	7	7	ma
D-C Grid Current	10	10	10	10	ma
Driver Output Power (approx.)	10	10	10	10	watts
Power Input	120	160	200	250	watts
Useful Power Output	65	90	110	140	watts

These typical performance figures were obtained by direct measurement in operating equipment. The output power is useful power measured in a load circuit. The driving power is the total power taken by the tube and a practical resonant circuit. In many cases with further refinement and improved techniques better performance might be obtained.

Effective 10-21-59 (Copyright 1959 by Eitel-McCullough, Inc.)

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	100 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 165 Mc.)

D-C Plate Voltage	400	600	800	1000	volts
D-C Screen Voltage	250	250	250	250	volts
D-C Grid Voltage	—90	—95	—100	—105	volts
D-C Plate Current	200	200	200	200	ma
D-C Screen Current	40	35	25	20	ma
D-C Grid Current	7	8	10	15	ma
Peak A-F Screen Voltage at crest of 100% Modulation	140	150	160	170	volts
Peak R-F Grid Input Voltage (approx.)	110	120	120	125	volts
Driving Power (approx.)	1	1	1.5	2	watts
Plate Dissipation	25	40	60	60	watts
Plate Power Input	80	120	160	200	watts
Plate Power Output	55	80	100	140	watts

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1250 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT (AVERAGE)	250 MAX. MA
PLATE DISSIPATION	150 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 216 Mc., 5-Mc. bandwidth)

D-C Plate Voltage	750	1000	1250	volts
D-C Screen Voltage	300	300	300	volts
D-C Grid Voltage	—60	—65	—70	volts
During Sync-Pulse Peak:				
D-C Plate Current	335	330	305	ma
D-C Screen Current	50	45	45	ma
D-C Grid Current	15	20	25	ma
Peak R-F Grid Voltage	85	95	100	volts
R-F Driver Power (approx.)	7	8	9	watts
Useful Power Output	135	200	250	watts
Black Level:				
D-C Plate Current	245	240	230	ma
D-C Screen Current	20	15	10	ma
D-C Grid Current	4	4	4	ma
Peak R-F Grid Voltage (approx.)	65	70	75	volts
R-F Driver Power (approx.)	4.25	4.7	5.5	watts
Plate Power Input	185	240	290	watts
Useful Power Output	75	110	140	watts

PLATE PULSED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

PULSED PLATE VOLTAGE	7000 MAX. VOLTS
PULSED SCREEN VOLTAGE	1500 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
MAXIMUM PULSE DURATION	5 MICROSECONDS
PULSED CATHODE CURRENT	7 MAX. AMPS
AVERAGE POWER INPUT	250 MAX. WATTS
PLATE DISSIPATION	150 MAX. WATTS
SCREEN DISSIPATION	15 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL PULSE OPERATION

Single tube oscillator, 1200-Mc.

Pulsed Plate Voltage	5	7	Kilovolts
Pulsed Plate Current	4.0	6.0	Amps.
Pulsed Screen Voltage	800	1000	Volts
Pulsed Screen Current	0.3	0.4	Amps.
D-C Grid Voltage	—200	—250	Volts
Pulsed Grid Current	0.5	0.6	Amps.
Pulse Duration	4	4	Microseconds
Pulse Repetition Rate	2500	1250	Per second
Peak Power Output	7	17	Kilowatts

APPLICATION

MECHANICAL

Mounting—The 4X150G may be mounted in any position. The concentric arrangement of the electrode terminals permits the use of the 4X150G in coaxial line type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. The presence of non-contacting, or intermittently-contacting, fingers may result in erratic circuit operation, particularly at very-high- or ultra-high-frequencies. Points of electrical contact should be kept clean and free of oxidation to minimize r-f losses.

Cooling—The 4X150G requires sufficient forced-air cooling to keep the cooler core and the metal parts of the metal-to-glass seals from exceeding a maximum temperature of 150°C. The air flow must be started when power is applied to the heater, and must continue without interruption until all electrode voltages have been removed from the tube.

Effective cooling of the anode is accomplished by directing six cubic feet per minute of air through the anode cooler. This flow is obtained at a pressure drop across the cooler of approximately 0.25 inch of water column. The grid, cathode and heater terminals are cooled by high velocity air directed at the terminals and the connecting collets which aid in the removal of heat from the terminals by conduction. The volume required will depend upon the socket arrangement and should be adequate to keep the metal-to-glass seals below 150°C and the center heater terminal below 200°C.

The air requirements stated above are based on op-

eration at sea level and an ambient temperature of 20°C. Operation at high altitudes or at high ambient temperatures requires a greater volume of air flow. The necessary design information for such conditions is contained in an article entitled "Blower Selection for Forced-Air-Cooled Tubes," by A. G. Nekut, in the August, 1950, issue of "Electronics."

Temperature of the external parts of a tube may be measured with the aid of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd street, New York 11, N. Y.

ELECTRICAL

Heater—The heater should be operated as close to 2.5 volts as possible, but it will withstand heater-voltage variations as great as 10% without injury. Some variation in power output must be expected to occur with variations of the heater voltage. In UHF operation of the 4X150G some advantage can be gained by operation of the heater at reduced voltages to compensate for cathode back-heating. Under conditions of operation for maximum power output at frequencies between 500 and 1000 Mc the heater voltage may be reduced to 2.4 volts. 2.3 volts is usually adequate for similar conditions at frequencies from 1000 to 1500 Mc.

Grid Dissipation—Grid-circuit driving-power requirements increase with increasing frequency because of losses other than grid dissipation. This becomes noticeable at frequencies above 150 megacycles and increases until at 500 Mc the required driving power may be as much as 15 watts in an ordinary circuit.

Despite the increased driving power required by the circuit as a whole at higher frequencies, the power actually dissipated at the tube grid does not increase greatly. Satisfactory operation in stable amplifier circuits is indicated by d-c grid-current values below approximately 15 milliamperes.

Screen Dissipation—Bias- or plate-supply failure or unloaded-plate-circuit operation can cause the screen current and dissipation to rise to excessive values. Protection for the screen can be provided by an overload relay in the screen circuit, in addition to the usual plate-overload relay. Use of a screen-current milliammeter is advisable.

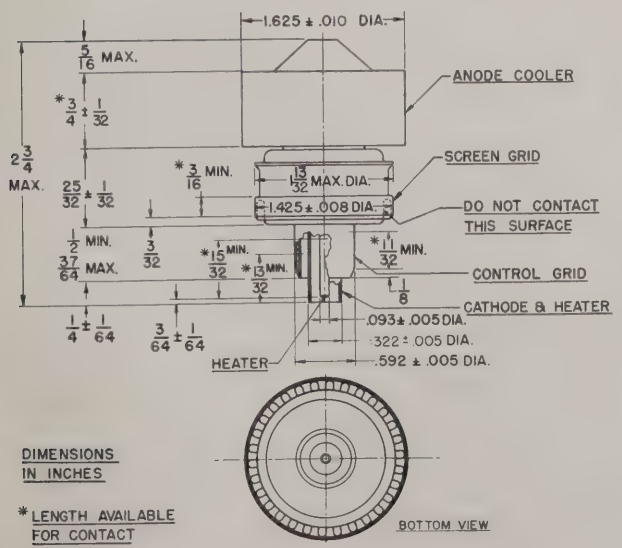
Plate Dissipation—The maximum-rated plate dissipation is 150 watts. The maximum-rated plate dissipation for plate-modulated applications is 100 watts under carrier conditions, which permits the plate dissipation to rise to 150 watts under 100% sinusoidal modulation. Plate dissipation may be permitted to exceed the maximum rating momentarily, as, for instance, during tuning procedures.

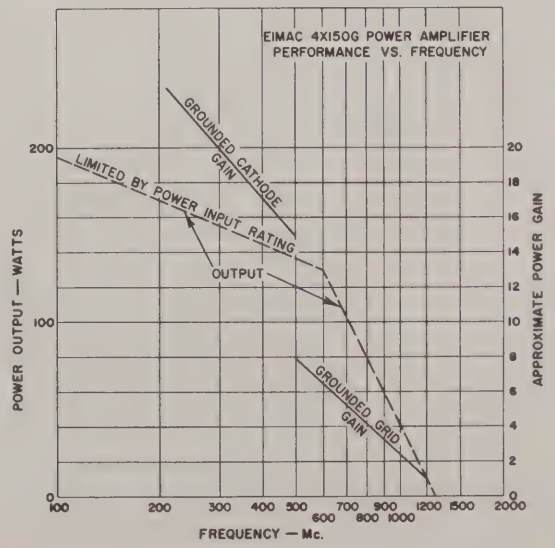
UHF Operation—Transit-time effects, which occur at ultra-high frequencies in the 4X150G, can be minimized by adherence to the operating practices suggested below:

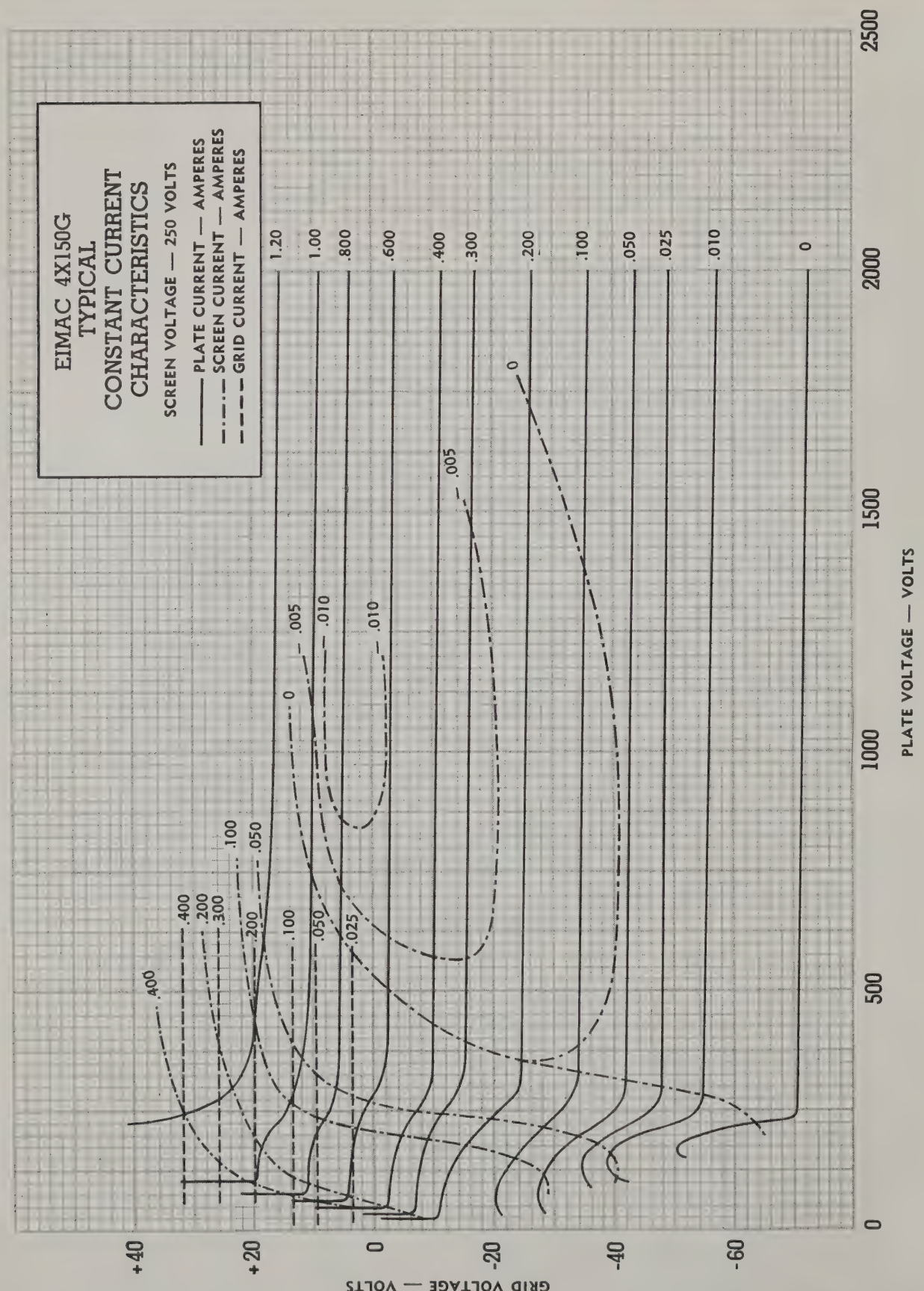
1. Use a minimum d-c bias voltage, not over twice cut-off.
2. Apply only enough drive to obtain satisfactory plate efficiency.
3. Operate the screen at reasonably high voltage, but do not exceed the screen-dissipation rating. The circuit should be loaded to obtain screen-current values close to those given under "Typical Operation" at 500 Mc.
4. Fairly heavy plate loading is required. In general, low-voltage, high-current operation is preferable to operation at high voltages and low currents. If conditions require a change to lighter plate loading, the drive should also be reduced to the minimum value for satisfactory operation at the new output level.
5. Parasitic oscillations are usually associated with excessive grid and screen currents and are injurious to vacuum tubes. Similarly, tuned-plate circuits which accidentally become simultaneously resonant to harmonics and the fundamental frequency may also cause low efficiency and resultant tube damage.

Plate Modulation—Plate modulation can be applied to the 4X150G when it is operated as a class-C radio-frequency amplifier. To obtain 100% modulation, the d-c screen voltage must be modulated in phase with the plate modulation. Self-modulation of the screen by means of a series resistor or reactor may not be satisfactory in this particular tetrode due the screen-voltage, screen-current characteristic.

Grid Resistance—In class-A and -AB_1 amplifiers, where no grid current flows, the grid-bias voltage may be applied through a resistor. The maximum permissible series resistance per tube is 100,000 ohms.







▶ Indicates change from sheet dated 9-1-55

Printed in U.S.A. 83457

TENTATIVE DATA

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4X250F

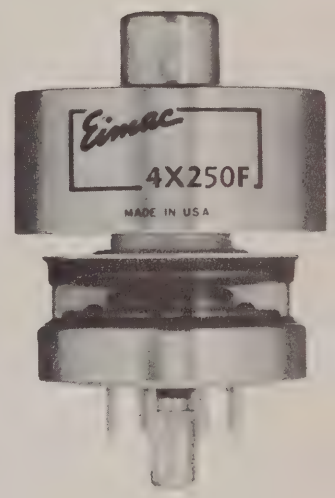
RADIAL-BEAM POWER TETRODE

The Eimac 4X250F is a compact, oxide-cathode, external-anode power tetrode, unilaterally interchangeable with the 4X150D in most applications, and is intended for use as an amplifier, oscillator or frequency multiplier over a wide range of frequencies extending into the UHF region. It is cooled by convection and forced air.

A single 4X250F in a coaxial-cavity amplifier circuit will deliver up to 300 watts of useful power output at 400 megacycles although this is not the upper frequency limit of the tube.

Outstanding features of the 4X250F are: 1. Simple air-cooling requirements. 2. A maximum plate dissipation rating of 250 watts available for low-efficiency applications. 3. A maximum d-c plate voltage rating of 2000 volts at frequencies up to 400 Mc. The high transconductance of the 4X250F makes the tube useful at relatively low plate voltages. The high ratio of transconductance to inter-electrode capacitance and the 250-watt plate dissipation make the tube very useful for wide-band amplifier applications.

The use of an Eimac Air-System Socket or a socket providing equivalent air cooling characteristics, is required.



GENERAL CHARACTERISTICS

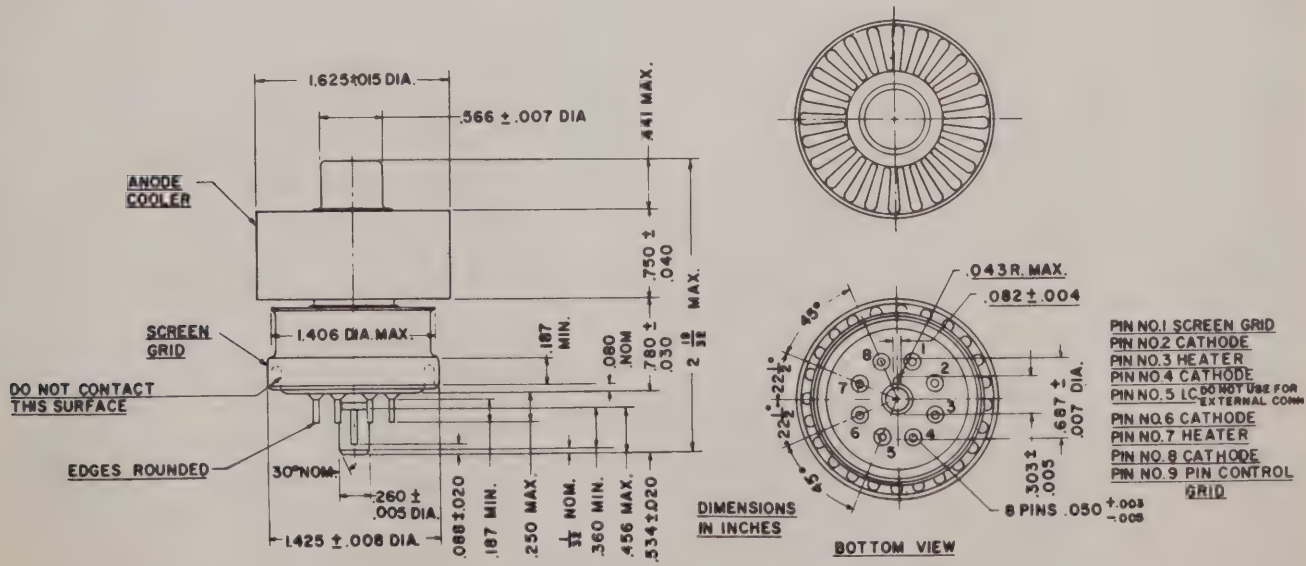
ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Minimum Heating Time	30	seconds
Cathode-to-Heater Voltage	150	max. volts
Heater: Voltage	26.5	volts
Current	0.50	amperes
Grid-Screen Amplification Factor (Average)	5	
Direct Interelectrode Capacitances (Average)		
Grid-Plate	0.04	μμf
Input	18.5	μμf
Output	4.7	μμf
Transconductance (E_b=500v., E_{c2}=250v., I_b=200 ma)	12,000	μmhos
Frequency for Maximum Plate Voltage Ratings	400	Mc

(All other Maximum Ratings applicable to 500 Mc)

MECHANICAL

Base	9-pin, special	
Recommended Socket	Eimac Air-System Socket	
Base Connections	See outline drawing	
Mounting	Any position	
Cooling	Convection and Forced air	
Maximum Over-all Dimensions		
Length	2.59	inches
Diameter	1.65	inches
Seated Height	2.03	inches
Net Weight	4.0	ounces
Shipping Weight	1.6	pounds



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RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175 Mc, per tube)

D-C Plate Voltage	500	1000	1500	2000	volts
D-C Screen Voltage	250	250	250	250	volts
D-C Grid Voltage	—90	—90	—90	—90	volts
D-C Plate Current	250	250	250	250	ma
D-C Screen Current	45	35	30	25	ma
D-C Grid Current	32	28	28	27	ma
Peak R-F Grid Voltage (approx.)	118	116	116	115	volts
Driving Power	3.6	3.2	3.2	2.8	watts
Plate Power Input	125	250	375	500	watts
Plate Power Output	85	195	300	410	watts

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	1500 MAX. VOLTS
D-C SCREEN VOLTAGE	300 MAX. VOLTS
D-C GRID VOLTAGE	—250 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION (Frequencies up to 175Mc, per tube)

D-C Plate Voltage	500	1000	1500	volts
D-C Screen Voltage	250	250	250	volts
D-C Grid Voltage	—100	—100	—100	volts
D-C Plate Current	200	200	200	ma
D-C Screen Current	45	35	25	ma
D-C Grid Current	22	19	17	ma
Peak R-F Grid Input Voltage	124	122	121	volts
Driving Power	2.7	2.3	2.1	watts
Plate Power Input	100	200	300	watts
Plate Power Output	75	160	250	watts

CLASS-AB POWER AMPLIFIER OR MODULATOR

MAXIMUM RATINGS (Per tube)

D-C PLATE VOLTAGE	2000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	12 MAX. WATTS
GRID DISSIPATION	2 MAX. WATTS

TYPICAL OPERATION
Class-AB_1 Audio Amplifier (Sinusoidal wave, two tubes unless otherwise noted)

D-C Plate Voltage	1000	1500	2000	volts,
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage (approx.)*	—50	—50	—50	volts
Zero-Signal D-C Plate Current	200	200	200	ma
Max-Signal D-C Plate Current	500	500	500	ma
Max-Signal D-C Screen Current	50	40	30	ma
Effective Load, Plate-to-Plate	3260	5760	8260	ohms
Peak A-F Grid Input Voltage (per tube)	50	50	50	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation (per tube)	125	150	175	watts
Max-Signal Plate Power Output	250	450	650	watts
Third-Harmonic Distortion	4.5	4.5	4.5	pct

*Adjust grid voltage to obtain specified zero-signal plate current

TYPICAL OPERATION
Class-AB_1 R-F Linear Amplifier (Frequencies to 175 Mc, per tube)

D-C Plate Voltage	1000	1500	2000	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage (approx.)*	—50	—50	—50	volts
Zero-Signal D-C Plate Current	100	100	100	ma
Max-Signal D-C Plate Current	250	250	250	ma
Max-Signal D-C Screen Current	25	20	15	ma
Peak R-F Grid Voltage	50	50	50	volts
Driving Power	0	0	0	watts
Max-Signal Plate Dissipation	125	150	175	watts
Max-Signal Plate Power Output	125	225	325	watts

*Adjust grid voltage to obtain specified zero-signal plate current

Note: Typical operation data are based on conditions of adjusting the r-f grid drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

APPLICATION

MECHANICAL

Mounting—The 4X250F may be mounted in any position. Use of an Eimac Air-System Socket, or its equivalent, is recommended.

The tube will fit a standard "loktal" socket, but the use of such a socket in the usual way prevents adequate air-cooling of the base of the tube. Use of the "loktal" socket is not recommended.

Connections to the terminals of all the electrodes except the plate are provided by the Air-System Socket. The anode-cooler assembly provides a terminal surface for the plate connection. For high-frequency applications a metal band or a spring-finger collet should be used to make good electrical contact with the cylindrical outer surface of the anode cooler. Points of electrical contact should be kept clean and free of oxidation to minimize r-f losses.

Cooling—The 4X250F requires sufficient cooling air to prevent the temperature of the metal part of the metal-to-glass seals exceeding a maximum of 175°C. The temperature of the anode as measured at the base of the cooling fins must be maintained below its maximum of 250°C.

Under conditions of normal room temperatures and installation in the Eimac Air-System Socket, the 4X250F requires no forced air during stand-by periods where only the heater power is on. Anode cooling air may be started and stopped simultaneously with the power on the anode. A quantity of 3.8 cubic feet per minute is required to cool the tube when operating at maximum-rated plate dissipation at 500 Mc. At this quantity of air the pressure drop across the cooler and the Air-System Socket is equal to approximately 0.25 inches of water column. At frequencies below 175 Mc and at 250 watts plate dissipation the quantity of air flow may be reduced to 3.6 cubic feet per minute, at which quantity the pressure drop is 0.23 inches of water column.

The air requirements stated above are based on operation at sea level and an ambient temperature of 20°C. Operation at high altitude or at high ambient temperatures requires a greater volume of air flow. The necessary design information for such conditions is contained in an article entitled "Blower Selection for Forced-Air-Cooled Tubes," by A. G. Nekut, in the August, 1950, issue of "Electronics."

One method of measuring temperature is provided by the use of "Tempilaq", a temperature-sensitive lacquer, which melts when a given temperature is reached. Where forced-air cooling is employed, very thin applications of the lacquer must be used. This product is obtainable from the Tempil Corporation, 11 West 25th St. New York 10, N. Y.

ELECTRICAL

Heater—The heater should be operated as close to 26.5 volts as possible, but it will withstand heater-voltage variations as great as 10% for short durations without injury. Some variations in power output must be expected to occur with variations of the heater voltage.

Cathode—The cathode is internally connected to the four even-numbered base pins. All four corresponding socket terminals should be used for connection to the external circuit. The leads should be of large cross-section and as short and direct as possible to minimize cathode-lead inductance.

Grid Dissipation—Grid-circuit driving-power requirements increase with frequency because of circuit losses other than grid dissipation. This becomes noticeable at frequencies near 100 Mc., and increases until at 500 Mc. as much as 20-25 watts driving power may be required in ordinary circuits.

Despite the increased driving power required by the circuit as a whole at higher frequencies, the power actually dissipated at the tube grid does not increase greatly. Satisfactory operation in stable amplifier circuits is indicated by d-c grid-current values below approximately 20 milliamperes.

Screen Dissipation—Bias- or plate-supply failure or unloaded-plate-circuit operation can cause the screen current and dissipation to rise to excessive values. Protection for the screen can be provided by an overload relay in the screen circuit, in addition to the usual plate-circuit overload relay. Use of a screen-current milliammeter is recommended.

Plate Dissipation—The maximum-rated plate dissipation is 250 watts. The maximum-rated plate dissipation for plate modulated applications is 165 watts under carrier conditions, which permits the plate dissipation to rise to 250 watts under 100% sinusoidal modulation.

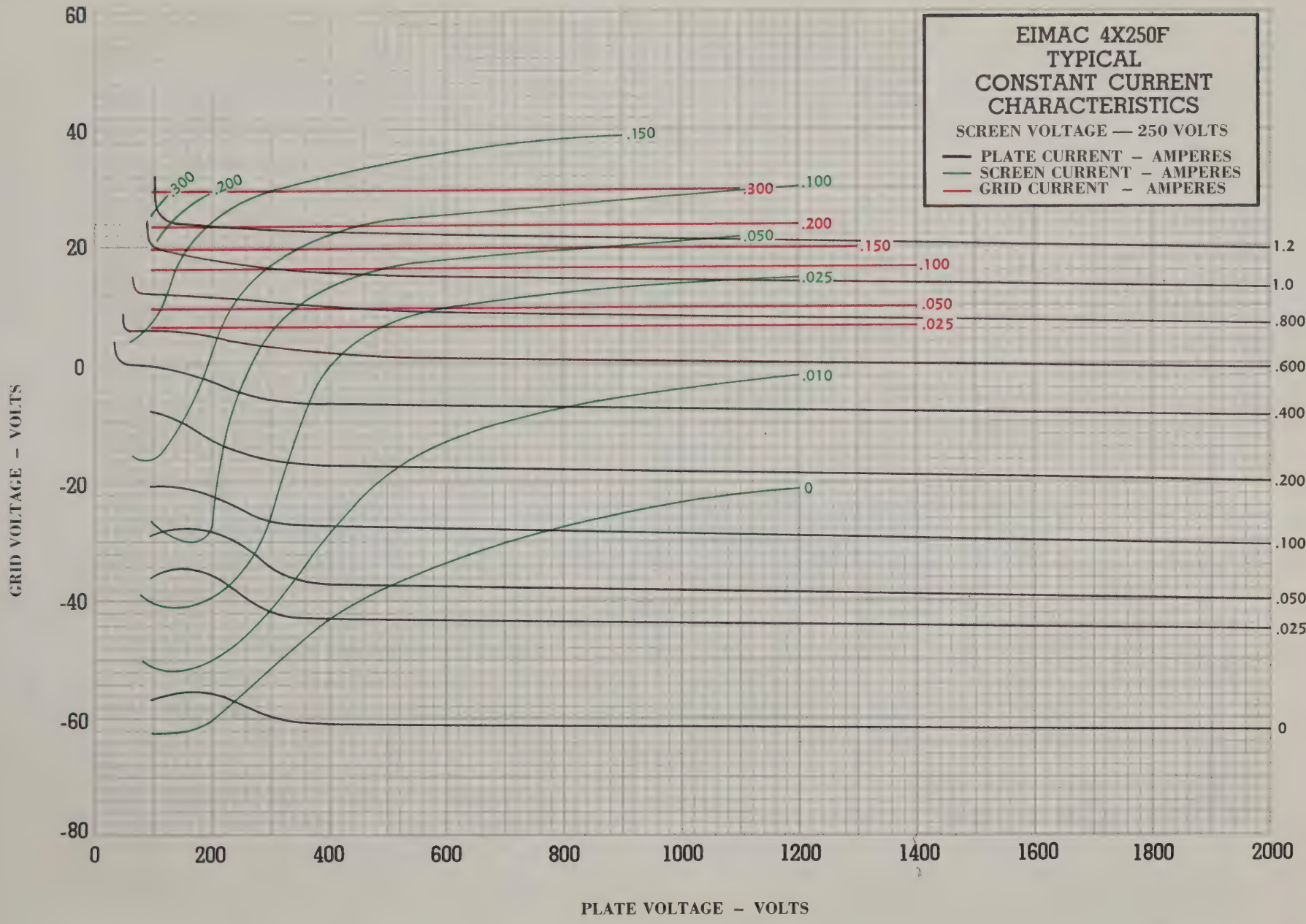
Plate dissipation may be permitted to exceed the maximum rating momentarily, as, for instance, during tuning.

UHF Operation—Transit time and other effects, which occur at ultra-high-frequencies in the 4X250F, can be reduced to minimum values by compliance with the following suggested operating conditions:

1. Use a minimum value of d-c grid bias voltage.
2. Apply only enough grid drive to obtain satisfactory plate efficiency.
3. Operate the screen at reasonably high voltage, but do not exceed the screen dissipation rating.
4. Fairly heavy plate loading is required. In general, low-voltage, high-current operation is preferable to operation at high voltage and low current. If conditions require a change to lighter plate loading, the drive should also be reduced to the minimum value for satisfactory operation at the new output level.
5. Parasitic oscillations are usually associated with excessive grid and screen current and are injurious to vacuum tubes. Similarly, tuned-plate circuits which accidentally become simultaneously resonant to harmonics and the fundamental frequency may also cause low efficiency and damage tubes.

Plate Modulation—Plate modulation can be applied to the 4X250F when it is operated as a class-C radio-frequency amplifier. To obtain 100% modulation, the d-c screen voltage must be modulated in phase with the plate modulation. Self-modulation of the screen by means of a series resistor or reactor may not be satisfactory in this particular tetrode due to the screen-voltage, screen-current characteristics.

Special Applications—If it is desired to operate this tube under conditions widely different than those given here, write to Eitel-McCullough, Inc., San Bruno, California, for information and recommendations.



Eimac 4X250F

Printed in U.S.A. I-C-8628

TENTATIVE DATA

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4X5000A

RADIAL-BEAM POWER TETRODE

The Eimac 4X5000A is a compact high power forced-air-cooled tetrode of metal and ceramic construction. The 4X5000A is useful as an oscillator, amplifier or modulator at frequencies up to 30 megacycles at full ratings. Its characteristics make it particularly useful as a linear single-sideband amplifier, class AB_1 audio amplifier or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The plate dissipation is rated at five kilowatts for most applications, and six kilowatts for Class-AB operation.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 volts
Current	75 amperes
Grid-Screen Amplification Factor (Average)	5

Direct Interelectrode Capacitances (Average)	Grounded Cathode	Grounded Grid
Feedback	0.75 uuf	0.14 uuf
Input	106 uuf	47 uuf
Output	18 uuf	18 uuf
Highest Frequency for Maximum Ratings		30 mc

MECHANICAL

Base	Special, Concentric
Recommended Socket	Eimac SK-300
Mounting	Axis vertical, base down or up
Cooling	Forced Air
Maximum Over-all Dimensions:	
Length	9-1/8 inches
Diameter	4-15/16 inches
Net Weight	9½ pounds
Shipping Weight (Approx.)	22 pounds

Note: Typical operation data are based on conditions of adjusting the r-f drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C, Key-down conditions, per tube:

MAXIMUM RATINGS

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	3.0 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 mc.)

D-C Plate Voltage	7500 volts
D-C Screen Voltage	500 volts
D-C Grid Voltage	–350 volts
D-C Plate Current	2.8 amperes
D-C Screen Current	0.5 amperes
D-C Grid Current	0.25 amperes
Peak R-F Grid Voltage	590 volts
Driving Power	150 watts
Grid Dissipation	60 watts
Screen Dissipation	250 watts
Plate Dissipation	5000 watts
Plate Power Output	16,000 watts

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PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony, Carrier Conditions unless otherwise specified, one tube:

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPERES
PLATE DISSIPATION*	3500 MAX. WATTS
SCREEN DISSIPATION	250 MAX. VOLTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, Frequencies below 30 mc.:

D-C Plate Voltage	5000 volts
D-C Screen Voltage	500 volts
D-C Grid Voltage	–400 volts
D-C Plate Current	1.4 amperes
D-C Screen Current	0.26 amperes
D-C Grid Current	0.050 amperes
Peak R-F Grid Voltage	520 volts
Grid Driving Power	25 watts
Grid Dissipation	6 watts
Screen Dissipation	130 watts
Plate Dissipation	1100 watts
Peak A-F Screen Voltage for 100% modulation	450 volts
Plate Power Output	5.8 kilowatts

*Corresponds to 5 kw at 100%, sine-wave modulation.

CLASS-AB RADIO-FREQUENCY OR AUDIO POWER AMPLIFIER

MAXIMUM RATINGS per tube:

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, Class-AB_1 R-F Linear Amplifier, one tube, Peak Envelope or Modulation Crest Conditions, Frequencies below 30 mc.:

D-C Plate Voltage	7500 volts
D-C Screen Voltage	1250 volts
D-C Grid Voltage*	–300 volts
D-C Plate Current	1.9 amperes
Zero-Signal Plate Current	0.50 amperes
D-C Screen Current	0.20 amperes
D-C Grid Current	0 amperes
Driving Power	0 watts
Peak R-F Grid Voltage	300 volts
Screen Dissipation	250 watts
Plate Dissipation	4200 watts
Plate Power Output**	10,000 watts

*Adjust grid voltage to obtain specified Zero-signal plate current.
**Peak envelope Power Output or R-F Power Output at crest of modulation envelope.

TYPICAL OPERATION, Class-AB_1 Audio Amplifier, two tubes unless otherwise specified:

D-C Plate Voltage	4000	5000	6000	7000 volts
D-C Screen Voltage	1250	1250	1250	1250 volts
D-C Grid Voltage	-270	-280	-310	-325 volts
D-C Zero-Signal Plate Current	1.25	1.00	0.83	0.70 amperes
D-C Max.-Signal Plate Current	5.10	4.40	4.25	3.65 amperes
D-C Zero-Signal Screen Current	0	0	0	0 amperes
D-C Max.-Signal Screen Current	0.35	0.33	0.30	0.24 amperes
Load Resistance, P-to-P	1500	2370	2940	4100 ohms
Peak A-F Driving Voltage	250	240	270	235 volts
Driving Power	0	0	0	0 watts
Max.-Signal Plate Dissipation	4200	4200	4200	4200 watts
Max.-Signal Power Output	11,500	13,500	17,000	17,500 watts

APPLICATION

MECHANICAL

Mounting—The 4X5000A must be mounted with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

Socket—The Eimac Air-System Socket Type SK-300 is designed especially for the concentric base terminals of the 4X5000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals, after which a duct guides it into the anode cooling fins.

Cooling—The maximum temperature rating for the external surfaces of the 4X5000A is 200°C. Sufficient forced air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic stem surfaces below 200°C.

When the tube is mounted in the Eimac SK-300 Socket, plate dissipation power of 5,000 watts requires 175 CFM air flow, corresponding to a pressure differential across tube and socket of 1.5 inches water column. Cooling at the 6,000-watt dissipation power level requires 210 CFM air flow, corresponding to a pressure differential of 2.25 inches water column across the tube and socket.

The flow rates and pressure differentials specified above apply to air at sea level pressure and at 20°C ambient temperature.

If the 4X5000A is operated in a socket of a design different from that of the SK-300, the air-flow rates must be determined independently for each design, using the maximum rated temperature as the criterion for satisfactory cooling.

A convenient method of measuring temperatures is the use of a temperature-sensitive paint, applied sparingly to the tube surfaces. When heavy coats are applied, the air-cooled surface of the paint may not reach the tube temperature because the paint conducts heat poorly and errors can occur. One type of temperature-sensitive paint can be obtained from the Tempil Corporation, 11 West 25th Street, New York, 10, N.Y.

The air inlet to the cooling system should be equipped with an effective air filter, which should be inspected periodically to assure adequate air flow into the system.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4X5000A is 7.5 volts. The actual operating voltage should be maintained within the range from 7.15 to 7.85 volts, as measured at the base of the tube.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4X5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

Grid Dissipation—The grid dissipation can be determined approximately by use of the expression:

$$P_{g1} = e_{cmp}\ I_c$$

where: P_{g1} = Grid dissipation, watts;
e_{cmp} = Peak grid-filament positive voltage, volts;
I_c = D-C grid current, amperes.

The value of the peak positive grid voltage can be measured by means of a suitable peak-reading vacuum tube voltmeter.

Screen Dissipation—The screen dissipation, in cases where there is no a-c applied to the screen, is the simple product of the screen voltage and the screen current.

In case the screen voltage is modulated, the screen dissipation will depend strongly on the loading, driving power, and carrier screen voltage.

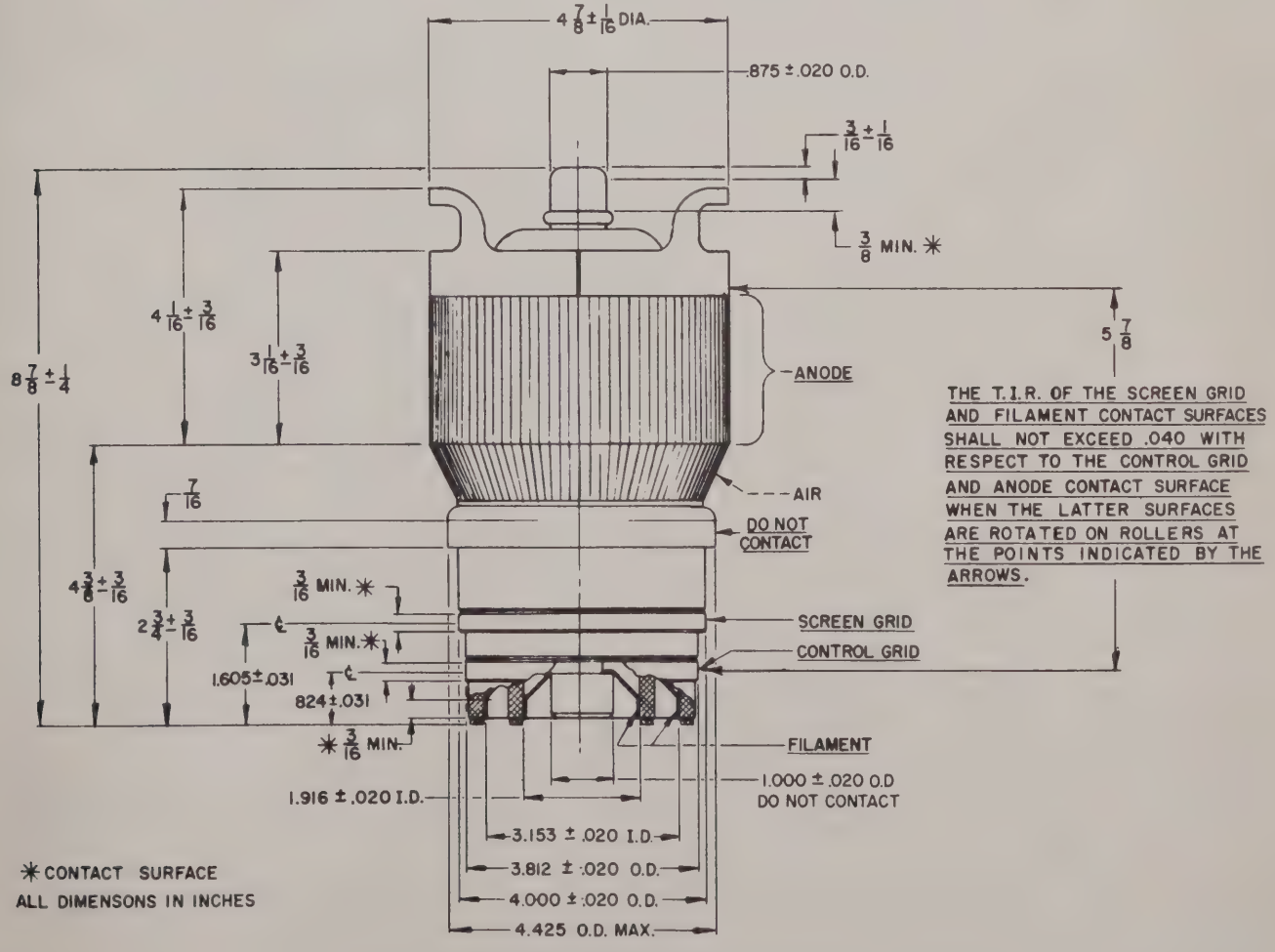
Plate Dissipation—The plate dissipation rating for the 4X5000A is 5000 watts for most applications, but for audio and SSB amplifier applications, the maximum dissipation rating is 6000 watts.

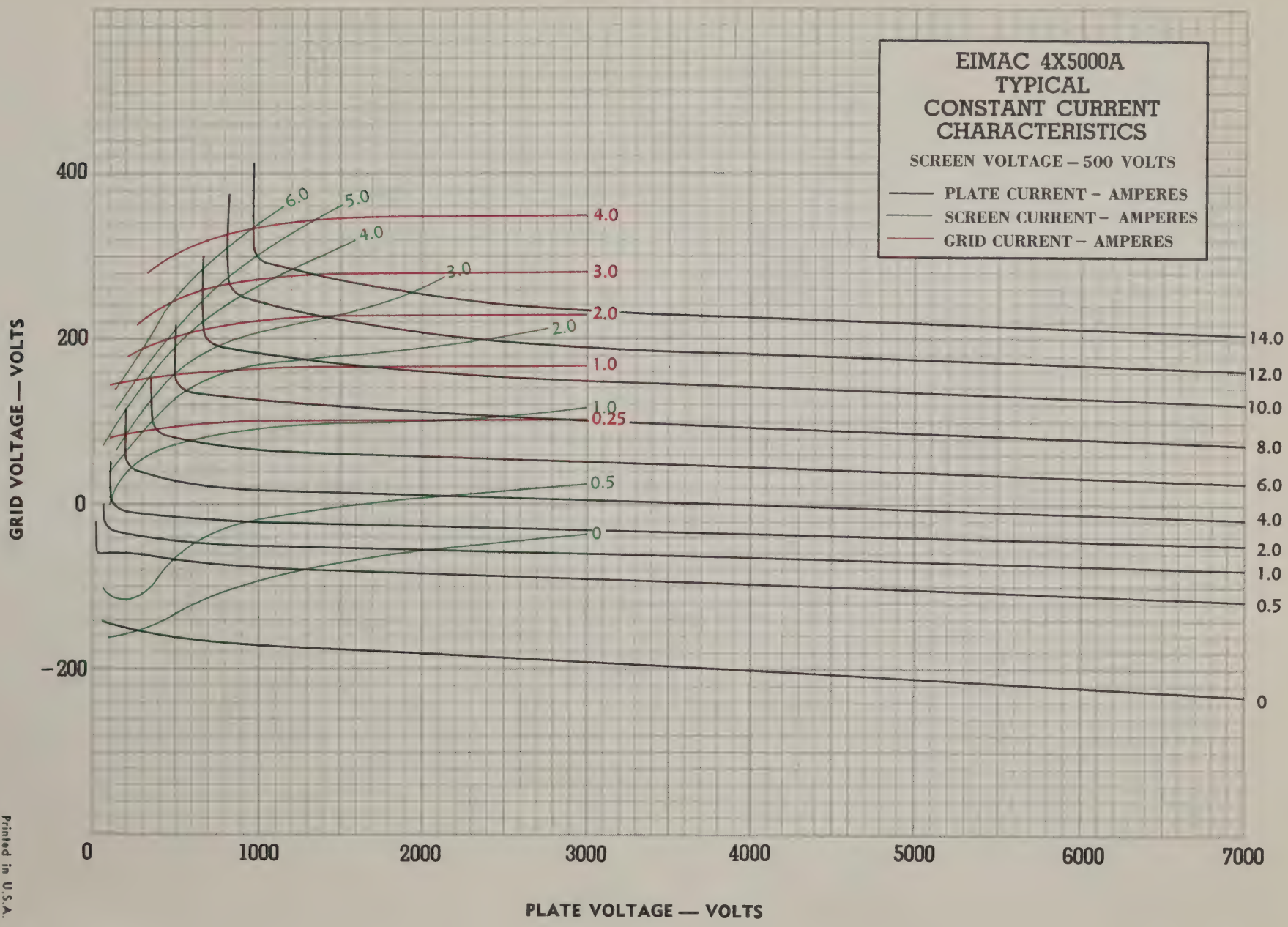
In class-AB and class-B amplifiers, the maximum plate dissipation does not coincide with maximum power output, but occurs at some lower power level determined jointly by the bias voltage and the driving voltage applied to the tube. Accordingly, it is advisable to limit the plate dissipation under full power conditions to approximately 70% of the maximum rated plate dissipation of the tubes used.

Screen modulated operation produces maximum plate dissipation under carrier conditions. The dissipation diminishes as the modulation increases.

When the 4X5000A is operated as a plate-modulated r-f power amplifier, the power input is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Eitel-McCullough, Inc., San Bruno, California, for information and recommendations.





Eimac 4X5000A

Printed in U.S.A. 13859

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4E27A/5-125B

RADIAL-BEAM POWER PENTODE

•

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 4E27A/5-125B is a power pentode intended for use as a modulator, oscillator or amplifier. The driving-power requirement is very low, and neutralization problems are simplified or eliminated entirely. The tube has a maximum plate-dissipation rating of 125 watts and a maximum plate voltage rating of 4000 volts at frequencies up to 75 Mc. Cooling is by convection and radiation. Type 4E27A/5-125B unilaterally replaces type 4E27.

The 4E27A/5-125B in class-C r-f service will deliver up to 375 watts plate power output with less than 2 watts driving power. It will deliver up to 75 watts of carrier for suppressor modulation.

Two 4E27A/5-125B's will deliver up to 300 watts maximum-signal plate power output in class AB_1 modulator service, 400 watts in class AB_2 with less than 1 watt driving power.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	5.0 volts
Current	7.5 amperes
Grid-Screen Amplification Factor (Average)	5.0
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.08 $\mu\mu$fd
Input	10.5 $\mu\mu$fd
Output	4.7 $\mu\mu$fd
Transconductance (I_b=50ma., E_b=2500v., E_{c2}=500v., E_{c3}= 0v.)	2150 μmhos
Highest Frequencies for Maximum Ratings	75 Mc.

MECHANICAL

Base	7-pin, metal shell
Connections	See drawing
Socket*	E. F. Johnson Co. No. 122-237, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Convection and radiation
Recommended Heat Dissipating Plate Connector	Eimac HR-5
Maximum Over-All Dimensions:	
Length	6.19 inches
Diameter	2.75 inches
Net Weight (Average)	6.0 ounces
Shipping Weight	2.0 pounds

*See "Cooling" under Application Notes.

Note: Typical operation data are based on conditions of adjusting to a specified plate current, maintaining fixed conditions of grid bias, screen voltage, suppressor voltage and r-f grid voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid, screen and suppressor currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony, Frequencies up to 75 Mc.
(Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C GRID VOLTAGE	−500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SUPPRESSOR DISSIPATION	20 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
60 Suppressor Volts, 500 Screen Volts

D-C Plate Voltage	1000	1500	2000	2500	3000	volts
D-C Grid Voltage	−120	−130	−150	−170	−200	volts
D-C Plate Current	167	200	200	186	167	ma
D-C Suppressor Current*	6	5	4	3	3	ma
D-C Screen Current*	11	11	11	7	5	ma
D-C Grid Current*	6	8	8	7	6	ma
Peak R-F Grid Input Voltage	170	200	222	240	260	volts
Driving Power*	1.0	1.6	1.8	1.7	1.6	watts
Grid Dissipation*	.3	.6	.6	.5	.6	watts
Screen Dissipation*	5.5	5.5	5.5	3.5	2.5	watts
Plate Dissipation	47	85	100	115	125	watts
Plate Power Input	167	300	400	465	500	watts
Plate Power Output	120	215	300	350	375	watts

TYPICAL OPERATION
Zero Suppressor Volts, 500 Screen Volts

D-C Plate Voltage	1000	1500	2000	2500	3000	volts
D-C Grid Voltage	−120	−130	−150	−170	−200	volts
D-C Plate Current	145	180	200	184	167	ma
D-C Screen Current*	17	20	23	18	12	ma
D-C Grid Current*	6	8	11	9	7	ma
Peak R-F Grid Input Voltage	170	200	240	250	270	volts
Driving Power*	1.0	1.6	2.6	2.3	1.9	watts
Grid Dissipation*	.3	.6	1.0	.8	.5	watts
Screen Dissipation*	8.5	10	12	9	6	watts
Plate Dissipation	55	95	125	125	125	watts
Plate Power Input	145	270	400	460	500	watts
Plate Power Output	90	175	275	335	375	watts

TYPICAL OPERATION
Zero Suppressor Volts, 750 Screen Volts

D-C Plate Voltage	1000	1500	2000	2500	3000	volts
D-C Grid Voltage	−170	−180	−200	−225	−250	volts
D-C Plate Current	160	200	200	186	167	ma
D-C Screen Current*	21	24	22	12	9	ma
D-C Grid Current*	3	6	6	4	3	ma
Peak R-F Grid Input Voltage	205	235	257	270	290	volts
Driving Power*	.6	1.4	1.5	1.1	.9	watts
Grid Dissipation*	.1	.4	.3	.2	.2	watts
Screen Dissipation*	16	18	17	9	7	watts
Plate Dissipation	45	85	100	115	125	watts
Plate Power Input	160	300	400	465	500	watts
Plate Power Output	115	215	300	350	375	watts

*Approximate Values

(Effective 8-15-52) Copyright, 1952 by Eitel-McCullough, Inc.

Supersedes Sheet Dated 12-1-49

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony, Frequencies up to 75 Mc.
(Carrier conditions, per tube, unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3200 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C GRID VOLTAGE	−500 MAX. VOLTS
D-C PLATE CURRENT	160 MAX. MA
PLATE DISSIPATION	85 MAX. WATTS
SUPPRESSOR DISSIPATION	20 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
Zero Suppressor Volts, 500 Screen Volts

D-C Plate Voltage	1000	1500	2000	2500	volts
D-C Grid Voltage	−190	−195	−200	−205	volts
D-C Plate Current	149	150	151	152	ma
D-C Screen Current*	20	18	17	16	ma
D-C Grid Current*	7	7	8	8	ma
Peak A-F Screen Voltage (100% Modulation)	350	350	350	350	volts
Peak R-F Grid Input Voltage	260	265	270	275	volts
Driving Power*	2	2	2	2	watts
Grid Dissipation*	0.5	0.5	0.5	0.5	watts
Screen Dissipation*	10	9	8.5	8	watts
Plate Dissipation	64	72	80	85	watts
Plate Power Input	149	225	300	380	watts
Plate Power Output	85	153	220	295	watts

SUPPRESSOR-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony, Frequencies up to 75 Mc.
(Carrier conditions, per tube, unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C GRID VOLTAGE	−500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SUPPRESSOR DISSIPATION	20 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1500	2000	2500	3000	volts
D-C Suppressor Voltage	−220	−260	−305	−350	volts
Peak A-F Suppressor Voltage (100% Modulation)	220	260	305	350	volts
D-C Screen Voltage	400	400	400	400	volts
Fixed D-C Screen Voltage	610	645	650	610	volts
Screen Dropping Resistor[1]	5500	9100	10,000	8300	ohms
D-C Grid Voltage	−170	−180	−190	−200	volts
D-C Plate Current	59	59	59	60	ma
D-C Screen Current*	38	27	25	25	ma
D-C Grid Current*	6	5	5	4	ma
Peak R-F Grid Input Voltage	230	235	245	250	volts
Driving Power*	1.4	1.3	1.2	1.2	watts
Grid Dissipation*	.35	.25	.25	.20	watts
Screen Dissipation*	15	11	10	10	watts
Plate Dissipation	54	68	87	105	watts
Plate Power Input	89	118	148	180	watts
Plate Power Output	35	50	61	75	watts

[1]Adjust to stated d-c screen voltage.

AUDIO-FREQUENCY POWER AMPLIFIER OR MODULATOR

Class-AB, Sinusoidal Wave

MAXIMUM RATINGS (Per Tube)

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	750 MAX. VOLTS
D-C GRID VOLTAGE	−500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SUPPRESSOR DISSIPATION	20 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION (Two tubes unless otherwise specified)
Class-AB_1

D-C Plate Voltage	1500	2000	2500	volts
D-C Suppressor Voltage	0	0	0	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage[1]	−70	−80	−85	volts
Zero-Signal D-C Plate Current	110	85	65	ma
Max-Signal D-C Plate Current	205	210	220	ma
Zero-Signal D-C Screen Current*	0	0	0	ma
Max-Signal D-C Screen Current*	15	13	8	ma
Effective Plate-to-Plate Load	13,700	18,000	20,000	ohms
Peak A-F Grid Voltage (per tube)	70	80	85	volts
Max-Signal Driving Power*	0	0	0	watts
Max-Signal Plate Power Input	310	420	550	watts
Max-Signal Plate Power Output	200	250	300	watts

[1]Adjust to stated zero-signal d-c plate current. The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

TYPICAL OPERATION (Two tubes unless otherwise specified)
Class-AB_2

D-C Plate Voltage	1500	2000	2500	volts
D-C Suppressor Voltage	60	0	0	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage[1]	−70	−80	−85	volts
Zero-Signal D-C Plate Current	110	85	65	ma
Max-Signal D-C Plate Current	365	295	250	ma
Zero-Signal D-C Screen Current*	0	0	0	ma
Max-Signal D-C Screen Current*	11	16	13	ma
Effective Plate-to-Plate Load	7300	13,000	20,000	ohms
Peak A-F Grid Input Voltage (per tube)	100	100	95	volts
Max-Signal Driving Power*	0.5	0.3	0.2	watts
Max-Signal Plate Power Input	550	590	625	watts
Max-Signal Plate Power Output	300	350	400	watts

[1]Adjust to stated zero-signal d-c plate current.
*Approximate values.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting—The 4E27A/5-125B must be mounted vertically, base down or up. The plate lead should be flexible, and the tube must be protected from vibration and shock.

Cooling—A heat dissipating connector (Eimac HR-5 or equivalent) is required at the plate terminal, and provision must be made for the free circulation of air through the socket and through the holes in the base. If the E. F Johnson Co. 122-237 socket recommended under "General Characteristics" is to be used, the model incorporating a ventilating hole should be specified.

At high ambient temperatures, at frequencies above 75 Mc., or when the flow of air is restricted, it may become necessary to provide forced air circulation in sufficient quantity to prevent the temperature of the plate and base seals from exceeding 225°C. Forced movement of air across the tube seals and envelope is always beneficial, though not necessarily required.

Tube temperatures may be measured with the aid of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N. Y.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the base pins, should be the rated value of 5.0 volts. Variations should be held within the range of 4.75 to 5.25 volts.

Grid Voltage—Although a maximum of —500 volts bias may be applied to the grid, there is little advantage in using bias voltages in excess of those listed under "Typical Operation," except in certain specialized applications.

When grid-leak bias is used, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired value from tube to tube.

In class-C operation, particularly at high frequency, both grid bias and grid drive should be only great enough to provide satisfactory operation at good plate efficiency.

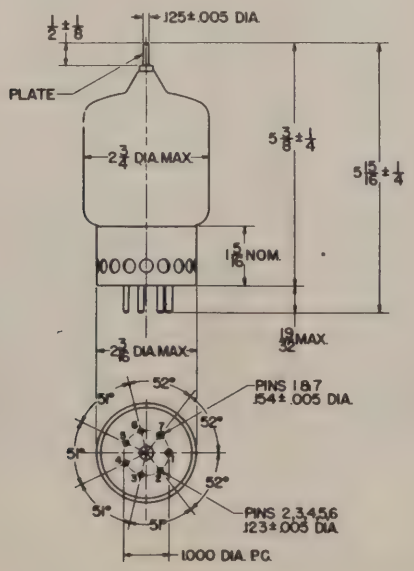
Screen Dissipation—Decrease or removal of plate load, plate voltage or bias voltage may result in screen dissipation in excess of the 20 watt maximum rating. The tube may be protected by an overload relay in the screen circuit set to remove the screen voltage when the dissipation exceeds 20 watts.

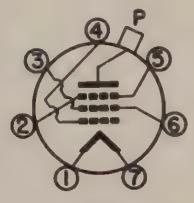
Resistors placed in the screen circuit for the purpose of developing an audio modulating voltage on the screen in modulated radio-frequency amplifiers should be made variable to permit adjustment when replacing tubes.

Plate Dissipation—Plate dissipation in excess of the 125-watt maximum rating is permissible for short periods of time, such as during tuning procedures.

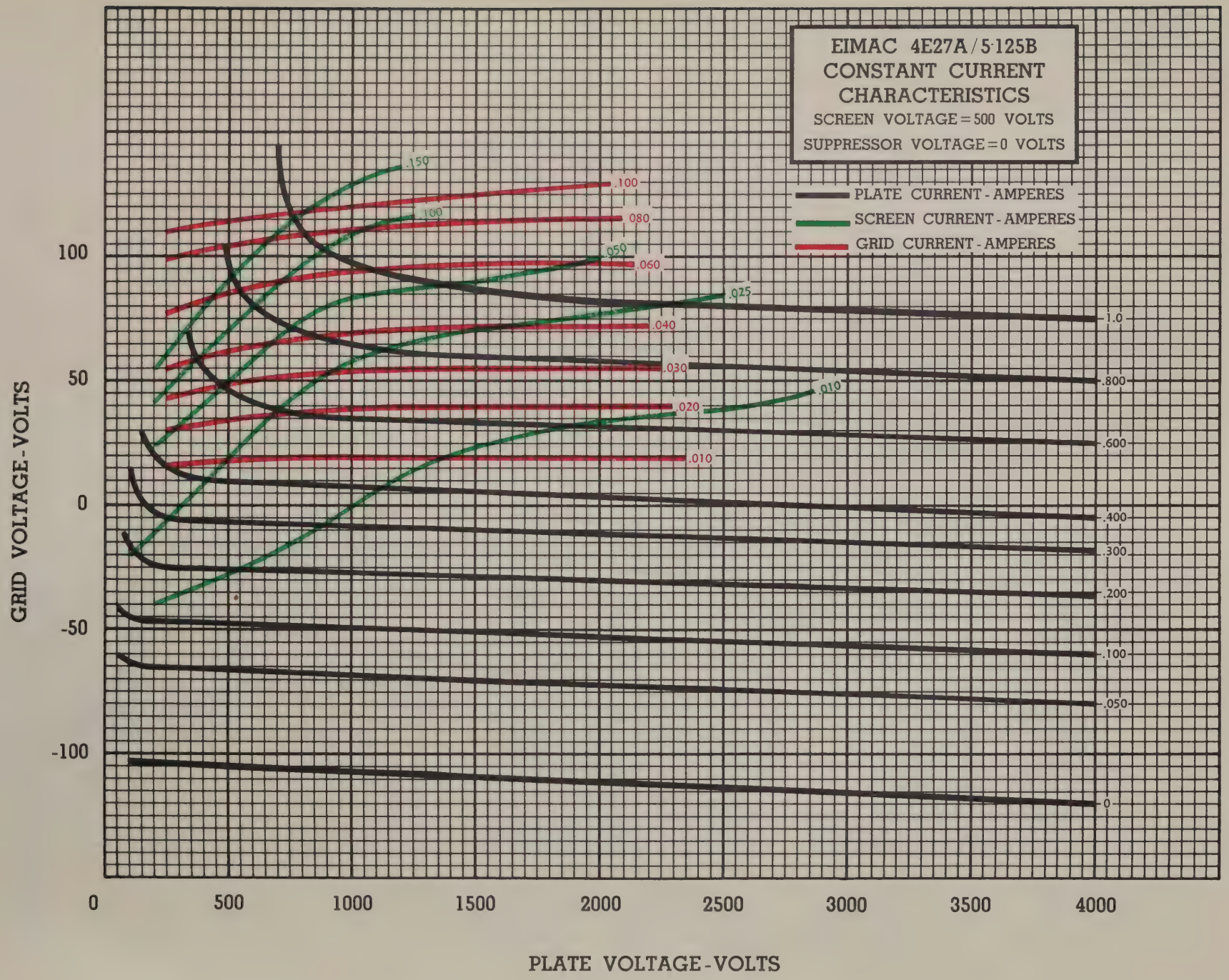
Operation—If reasonable precautions are taken to prevent coupling between the input and output circuits, the 4E27A/5-125B may usually be operated at frequencies up to 75 Mc. without neutralization. A conventional method of obtaining the necessary shielding between the grid and plate circuits is to use a suitable metal chassis with the grid circuit mounted below the deck and the plate circuit above. The tube socket should be mounted flush with the under side of the chassis deck, and spring fingers mounted around the socket opening should make contact between the chassis and the metal base shell of the tube. Power-supply leads entering the amplifier should be by-passed to ground and properly shielded. The output circuit and antenna feeders should be arranged so as to preclude any possibility of feedback to other circuits.

Feedback at high frequencies may be due to the inductance of leads, particularly those of the screen and suppressor-grids. By-passing methods and means of placing these grids at r-f ground potential are discussed in Application Bulletin Number Eight, "The Care and Feeding of Power Tetrodes," available from Eitel-McCullough, Inc., for twenty-five cents. Much of the material contained in this bulletin may be applied to pentodes.

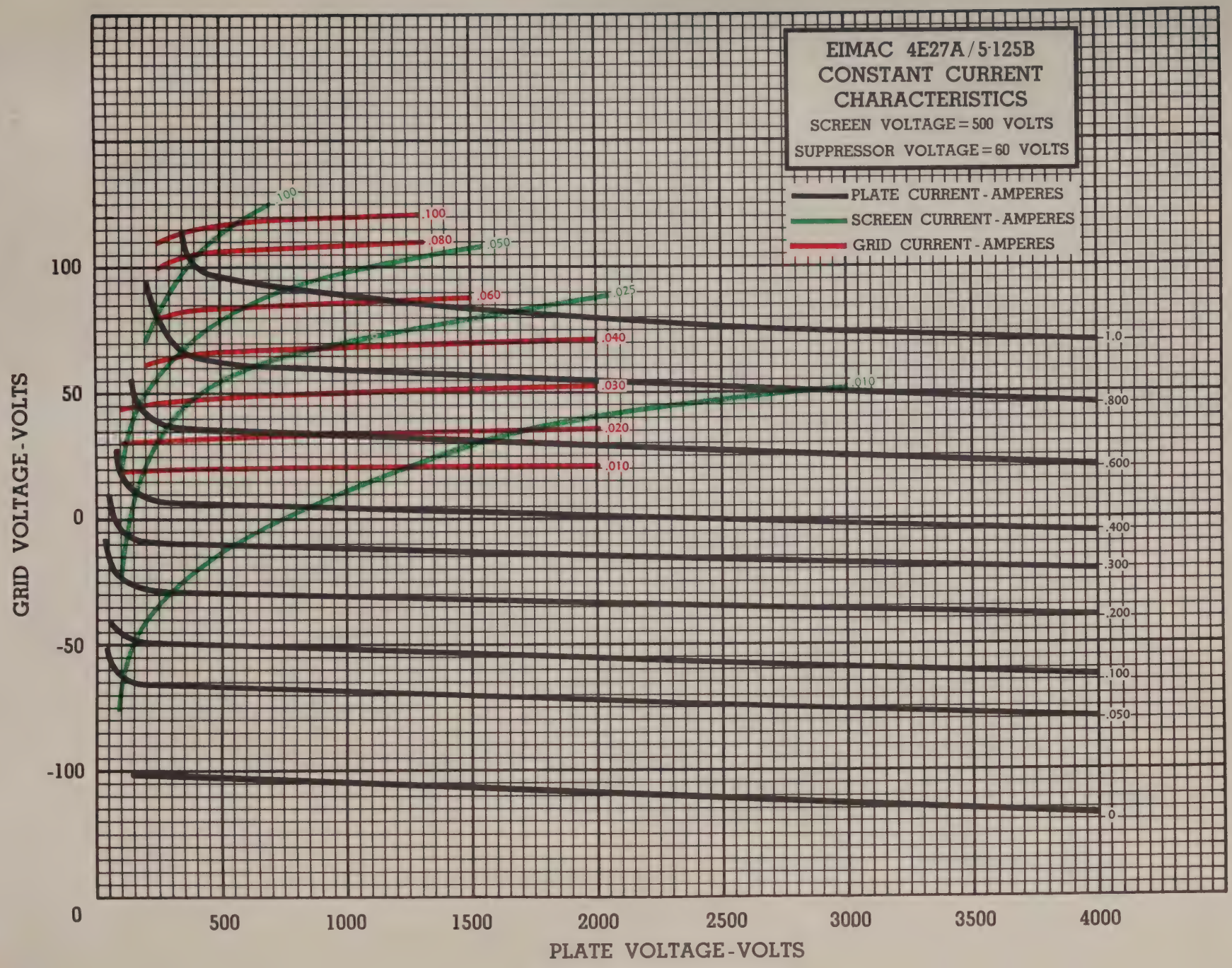


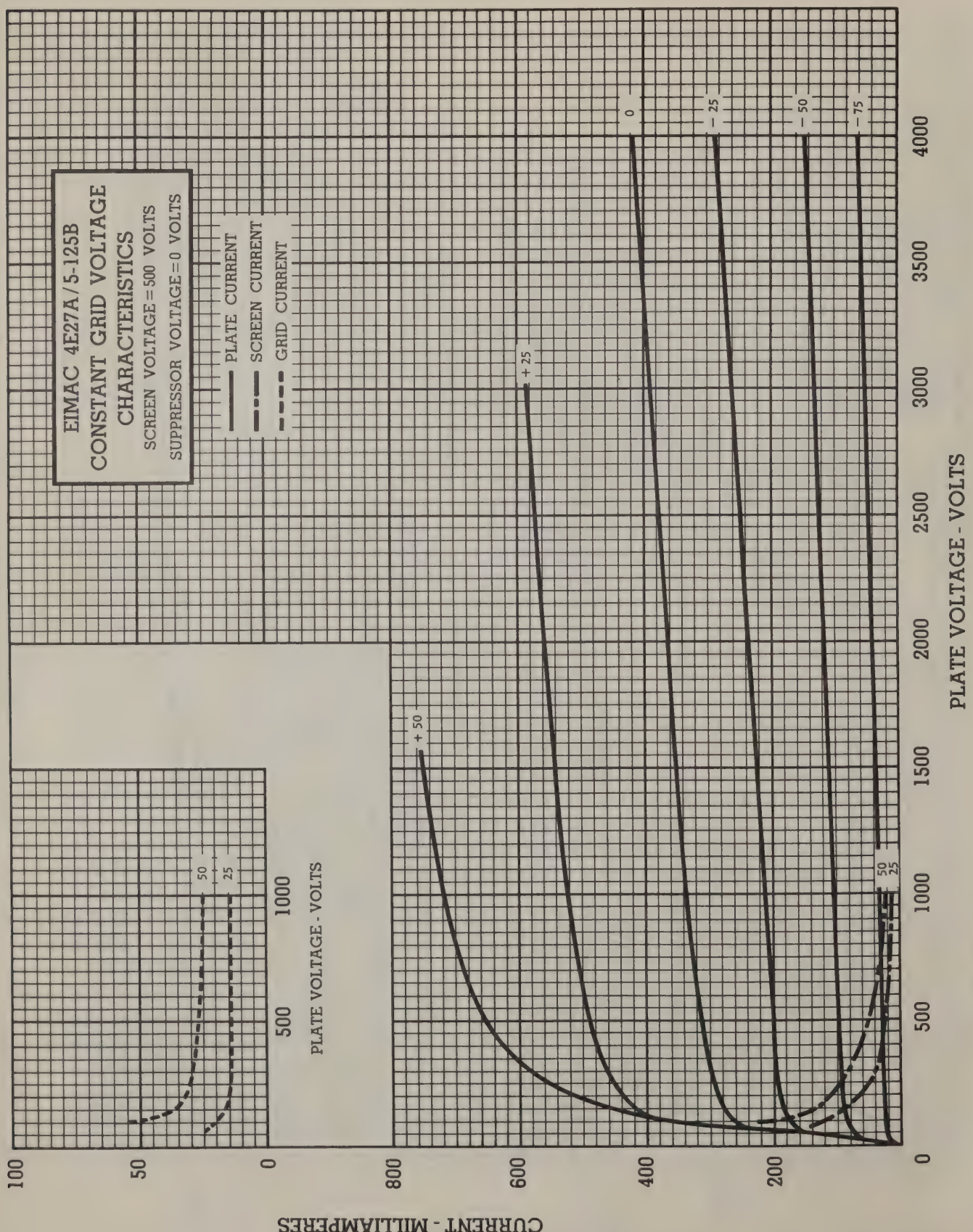


7BM



Eimac
4E27A/5-125B


EIMAC 4E27A/5-125B
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
SUPPRESSOR VOLTAGE = 60 VOLTS
PLATE CURRENT - AMPERES
SCREEN CURRENT - AMPERES
GRID CURRENT - AMPERES
GRID VOLTAGE - VOLTS
100
50
0
-50
-100
0
500
1000
1500
2000
2500
3000
3500
4000
PLATE VOLTAGE - VOLTS
.100
.080
.060
.040
.030
.020
.010
.100
.050
.025
.010
1.0
.800
.600
.400
.300
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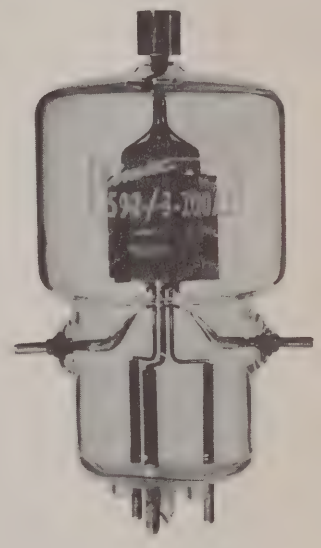
592/3-200A3

MEDIUM-MU TRIODE

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 592/3-200A3 is a medium-mu power triode having a maximum plate dissipation rating of 200 watts, and it is intended for use as a power amplifier, oscillator, or modulator. It can be used at its maximum ratings at frequencies as high as 150 Mc.

Cooling of the 592/3-200A3 is accomplished by radiation from the plate, which operates at a visible red color at maximum plate dissipation, and by means of forced-air circulation around the envelope.



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated tungsten	
Voltage	10.0 volts
Current	5.0 amperes
Amplification Factor (Average)	25
Direct Interelectrode Capacitances (Average)	
Grid-Plate	3.3 $\mu\mu$f
Grid-Filament	3.6 $\mu\mu$f
Plate-Filament	0.29 $\mu\mu$f
Transconductance (I_b=200 ma., E_b=3000 v.)	3600 μmhos
Frequency for Maximum Ratings	150 Mc.

MECHANICAL

Mounting	Vertical
Maximum Over-all Dimensions:	
Length	6.0 inches
Diameter	3-13/32 inches
Net Weight (approx.)	6 ounces
Shipping Weight (approx.)	1½ pounds
Cooling	Radiation and Forced-Air
Recommended Heat Dissipating Connectors:	
Plate	Eimac HR-10
Grid	Eimac HR-5

Maximum bulb temperature - - - - 225° C

Maximum seal temperature - - - - 175° C

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR—CLASS B

MAXIMUM RATINGS, PER TUBE

D-C PLATE VOLTAGE	3500 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	250 MAX. MA.
PLATE DISSIPATION	200 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

TYPICAL OPERATION
Sinusoidal wave, two tubes unless otherwise specified.

D-C Plate Voltage	2000	2500	3000	Volts
D-C Grid Voltage (approx.)*	—50	—70	—90	Volts
Zero-Signal D-C Plate Current	120	100	80	Ma.
Max-Signal D-C Plate Current	500	450	400	Ma.
Effective Load, Plate-to-Plate	8500	12,600	18,000	Ohms
Peak A-F Grid Input Voltage (per tube)	260	270	270	Volts
Max-Signal Peak Driving Power	50	52	40	Watts
Max-Signal Nominal Driving Power (approx.)	25	26	20	Watts
Max-Signal Plate Power Output	600	725	820	Watts

*Adjust to give stated zero-signal plate current.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	2600 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA.
PLATE DISSIPATION	130 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	2000	2500	Volts
D-C Plate Current	200	200	Ma.
D-C Grid Voltage	—250	—300	Volts
D-C Grid Current	35	35	Ma.
Peak R-F Grid Input Voltage	480	535	Volts
Driving Power	17	19	Watts
Grid Dissipation	8	9	Watts
Plate Power Input	400	500	Watts
Plate Dissipation	115	125	Watts
Plate Power Output	285	375	Watts

The output figures do not allow for circuit losses.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, per tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3500 MAX. VOLTS
D-C PLATE CURRENT	250 MAX. MA.
PLATE DISSIPATION	200 MAX. WATTS
GRID DISSIPATION	25 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	2000	2500	3000	3500	Volts
D-C Plate Current	250	228	222	228	Ma.
D-C Grid Voltage	—150	—180	—220	—270	Volts
D-C Grid Current	32	28	25	30	Ma.
Peak R-F Grid Input Voltage	380	400	440	505	Volts
Driving Power	12	11	11	15	Watts
Grid Dissipation	7	6	5.5	7	Watts
Plate Power Input	500	570	666	800	Watts
Plate Dissipation	200	200	200	200	Watts
Plate Power Output	300	370	466	600	Watts

The output figures do not allow for circuit losses.

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APPLICATION

MECHANICAL

Mounting—The 592/3-200A3 must be mounted vertically, base down or base up. Flexible connecting straps should be provided from the grid and plate terminals to the external grid and plate circuits. The tube must be protected from severe vibration and shock.

Cooling—An air-flow of approximately 15 cubic feet per minute should be directed at the bulb from a 2 inch diameter nozzle located about three inches from the center line of the tube. The center line of the nozzle should be located about two inches down from the top of the plate terminal. The incoming air temperature should not exceed 50° C. Other methods of cooling may be used provided the maximum bulb and seal temperatures are not exceeded. An 8 inch, household-type fan located about 10 inches from the tube is one alternate method. Special heat-dissipating connectors (Eimac HR-5 and HR-10, or equivalent, for grid and plate terminals respectively) should be used with this tube. These connectors help to prolong tube life by reducing the temperature of the metal-glass seals.

ELECTRICAL

Filament Voltage—For maximum tube life, the filament voltage, as measured directly at the filament pins, should be the rated value of 10.0 volts. Unavoidable variations in filament voltage must be kept within the range of 9.5 to 10.5 volts.

Bias Voltage—There is little advantage in using bias voltages in excess of those given under "Typical Operation" except in certain very specialized applications. Where bias is obtained by a grid leak, suitable protective means must be provided to prevent excessive plate dissipation in the event of loss of excitation.

Grid Dissipation—The power dissipated by the grid of the 592/3-200A3 must not exceed 25 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = grid dissipation,

e_{cmp} = peak positive grid voltage, and

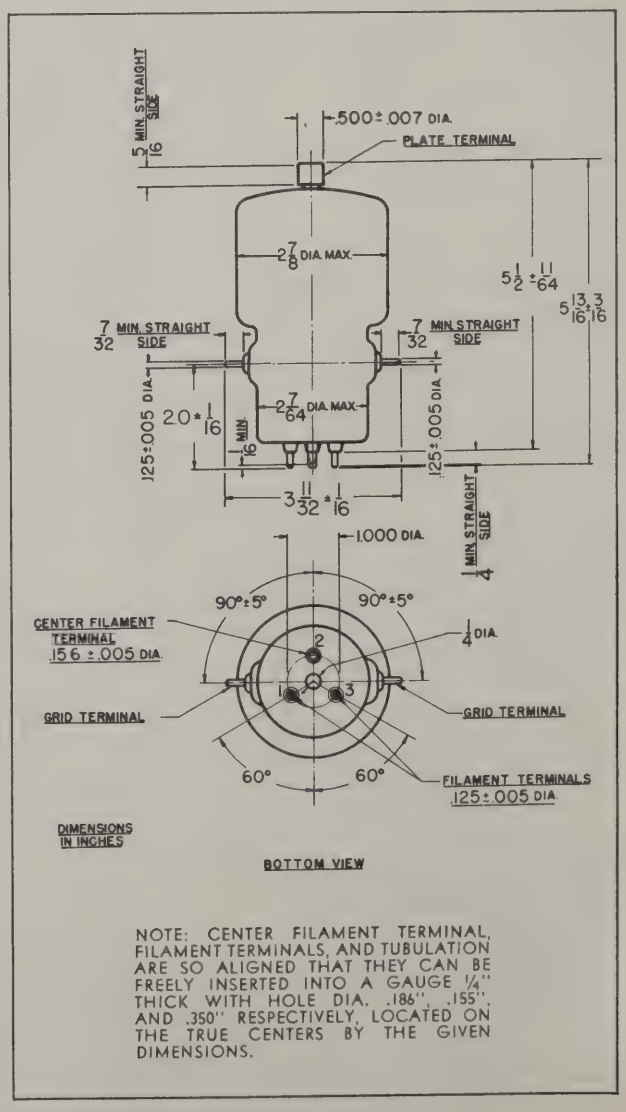
I_c = d-c grid current.

e_{cmp} may be measured by means of a suitable peak-reading voltmeter connected between filament and grid.*

Plate Voltage—Except for special applications, the plate supply voltage for the 592/3-200A3 should not exceed 3500 volts. In most cases there is little advantage in using plate-supply voltages in excess of those given under "Typical Operation" for the power output desired.

Plate Dissipation—Under normal operating conditions, the power dissipated by the plate of the 592/3-200A3 should not exceed 200 watts. At this dissipation the brightness temperature of the plate will appear a red-orange in color. The value of this color is somewhat affected by light from the filament, as well as from external sources. Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

*For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," **Eimac News**, January, 1945. This article is available in reprint form on request.

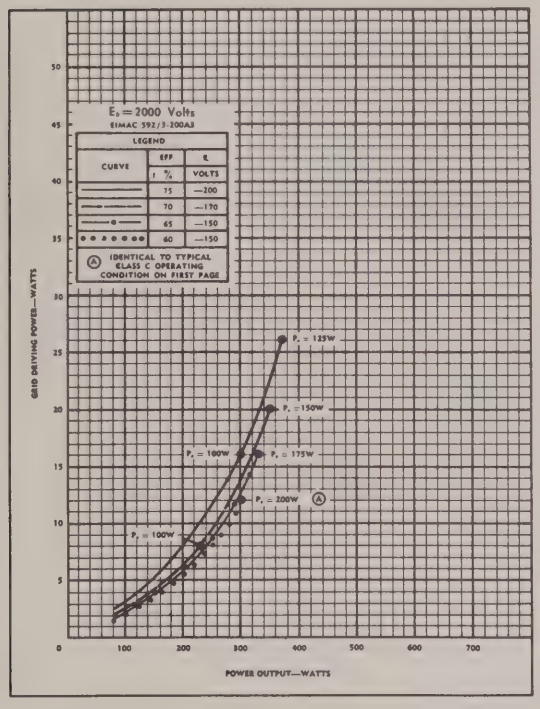


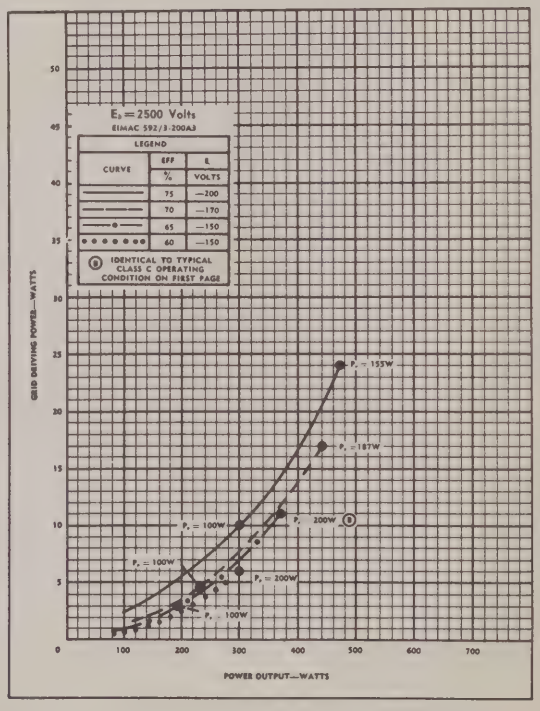
NOTE: CENTER FILAMENT TERMINAL, FILAMENT TERMINALS, AND TUBULATION ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAUGE 1/4" THICK WITH HOLE DIA. .186", .155", AND .350" RESPECTIVELY, LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS.

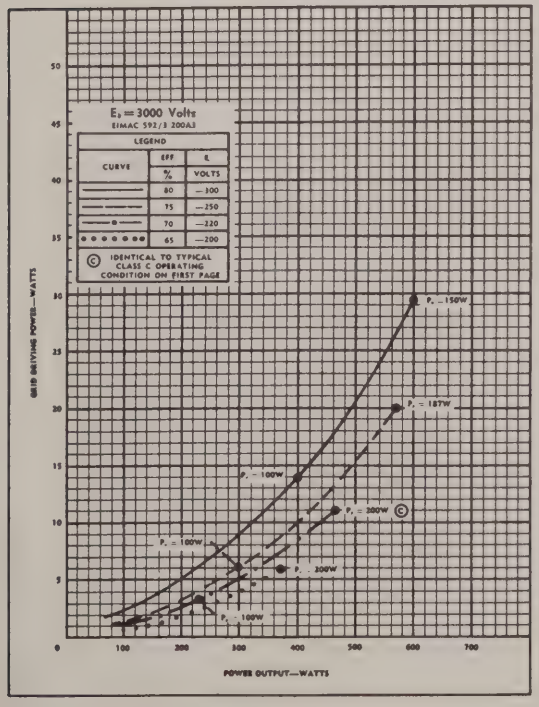
DRIVING POWER vs. POWER OUTPUT

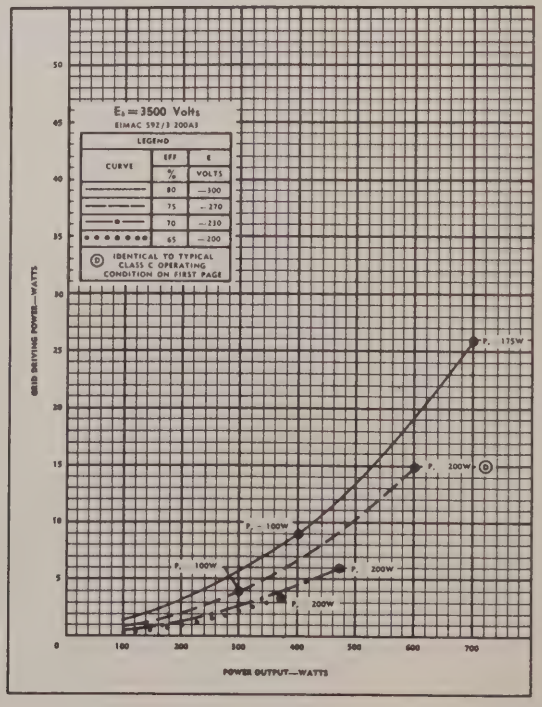
The four charts on this page show the relationship of plate efficiency, power output and grid driving power at plate voltages of 2000, 2500, 3000 and 3500 volts. These charts show combined grid and bias losses only. The driving power and power output figures do not include circuit losses. The plate dissipation in watts is indicated by P_p.

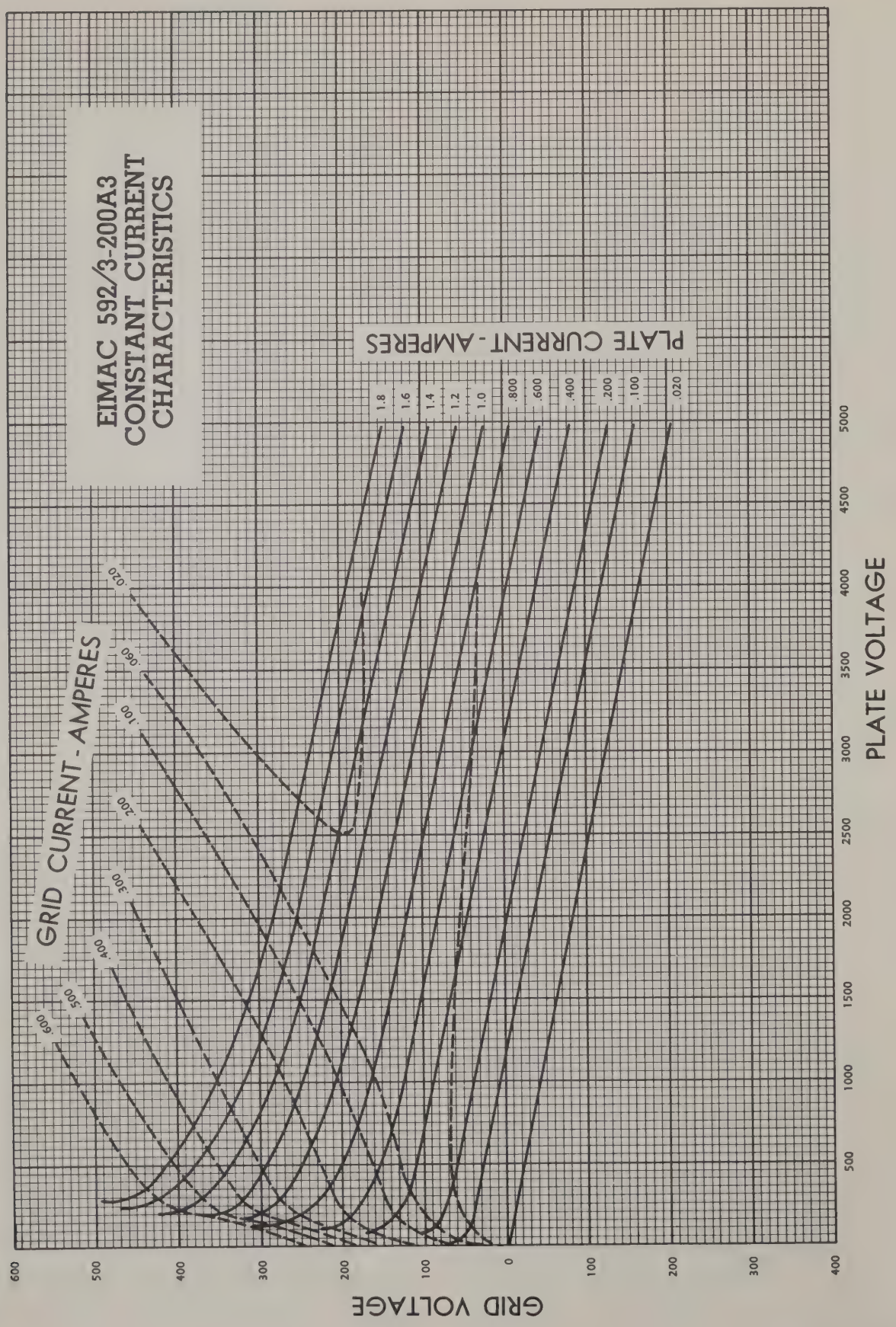
Points A, B, C, and D are identical to the typical Class C operating conditions shown on the first page under 2000, 2500, 3000 and 3500 volts respectively.











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IMPORTANT EIMAC "EXTRAS"

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other products



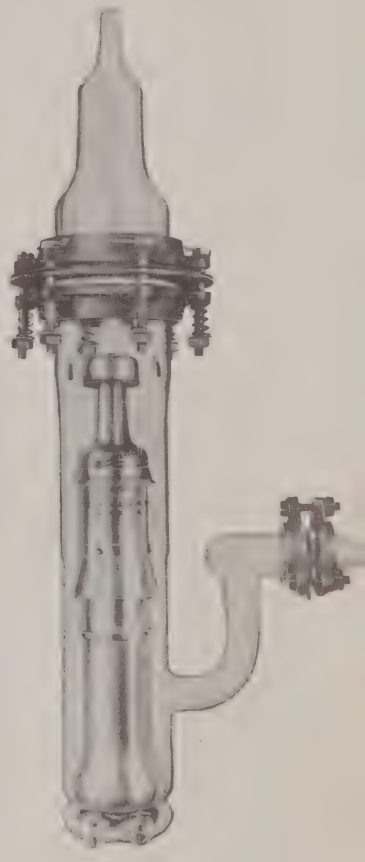
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

HV-1 DIFFUSION PUMP

The Eimac HV-1 Diffusion Pump is a fast, triple-jet, air-cooled vacuum pump of the oil-diffusion type. When used with a suitable mechanical forepump and a DC704 type oil it is capable of reaching an ultimate vacuum of 4×10^{-7} mm of mercury.

Assembly of the pump is a simple operation, requiring no special tools or intricate adjustments. It can be completely disassembled in five minutes or less.

The glass construction permits rapid inspection of conditions within the pump.



OPERATIONAL DATA

Amount of Oil	150 milliliters
Recommended Oil	DC704, Narcoil Octoil S.
Forepump Capacity*	0.1 to 2.0 liters per second at 0.001 mm of mercury, or less
Forepressure (maximum)	0.02 mm of mercury
Baffle Temperature	35° C or lower
Heater Voltage	100 to 110 volts
Heater Current (at 110 volts)	1.7 amperes
Speed, without baffle (approx.)*	67 liters per second at 4×10^{-4} to 4×10^{-6} mm Hg
Speed, with baffle (approx.)*	32 liters per second at 4×10^{-4} to 4×10^{-6} mm Hg
Ultimate Vacuum, at 25° C (approx.)	10^{-6} mm Hg when using recommended oil.
Using liquid N_2 Trap	10^{-7} mm Hg

MECHANICAL DATA

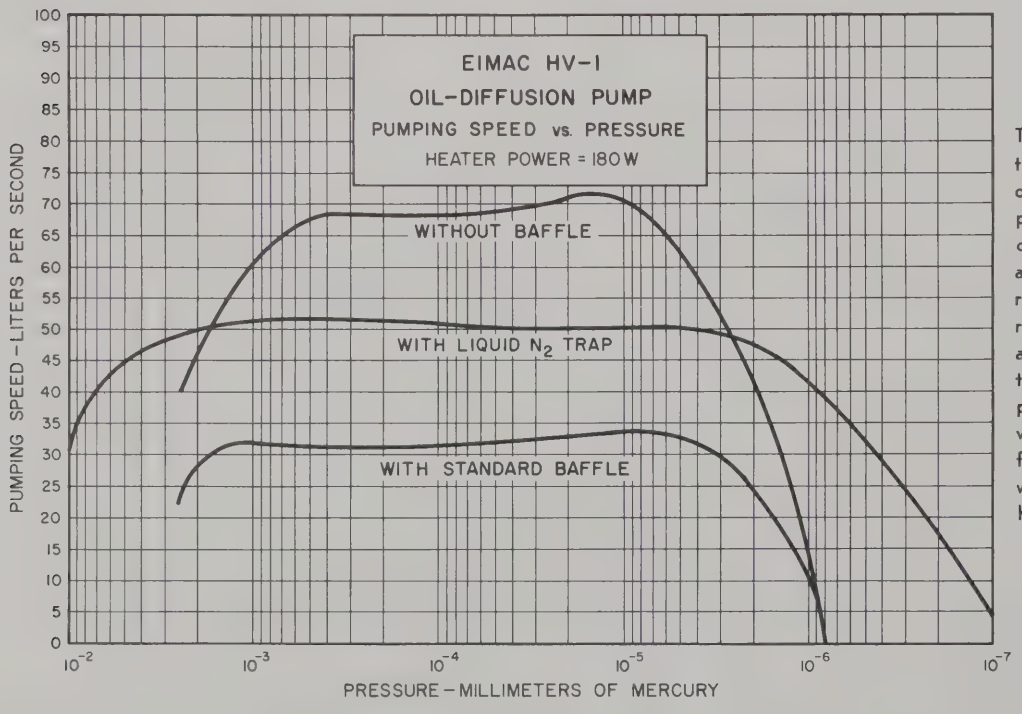
Casing	Pyrex Glass
Chimney	3 Jet, Aluminum
Cooling	Air
Maximum Overall Dimensions	See Outline Drawing
Mounting Position	Vertical, boiler down
Net Weight	6 pounds
Shipping Weight	18 pounds

* A small forepump may be used, but this will reduce the pumping speed at the higher manifold pressures.

(Effective 11-1-60) Copyright 1960 by Eitel-McCullough, Inc.

OPERATION

The principle upon which the oil-diffusion pump operates may be explained as follows. The drawing on page three illustrates the accepted theory. Gas to be removed from the high-vacuum system enters the pump at the top, and then into the region of the upper jet. Emerging from this jet is a stream of oil vapor which is generated by the electrically heated oil boiler at the bottom of the pump. Molecules of the unwanted gas diffuse into this stream of oil vapor and are carried down and out toward the cooler glass-wall of the pump. Upon reaching the glass-wall, the oil vapor condenses to a film of liquid oil which runs down the wall and returns to the boiler. The gas molecules are forced downward by the oil vapor and gas above them and come under the influence of the middle jet, where they are again forced down toward the bottom of the pump by a second stream of oil vapor.



The curves at the left show the gas handling capabilities of the HV-1 over a range of pressures both with and without a baffle. These curves apply when a forepump with the required capacity is used. The rapid loss in pumping speed at the higher pressures is due to the inability of the forepump to handle the necessary volume of gas. With a larger forepump, the pumping speed would be maintained out to higher pressures.

The process of entraining the molecules of gas down toward the bottom of the pump is again repeated at the bottom jet. During pumping, as the manifold pressure drops, the amount of oil issuing from the lower jet is sufficient to form a visible ring of oil on the wall of the pump at a point well below the bottom skirt. In this region the concentration of gas is great enough to raise the pressure to a level which will allow a mechanical forepump to effectively remove the gas from the system.

To prevent small amounts of oil vapor from finding their way back into the high-vacuum side of the system, a baffle is often employed between the diffusion pump and the high-vacuum system. In the HV-1 this baffle is a pair of aluminum discs which are kept relatively cool by the pump cooling fan. Oil vapor reaching the baffle condenses and returns to the boiler. The baffle reduces the pumping speed by about one-half. This is well illustrated in the curves. Constrictions or bends in the system are to be avoided wherever possible. A short length of small-bore tubing can cause a considerable reduction in pumping speed.

Pumping speed is also affected by the capabilities of the forepump. The forepump must be able to remove the gas from the system while maintaining the required low pressure at its end of the diffusion pump.

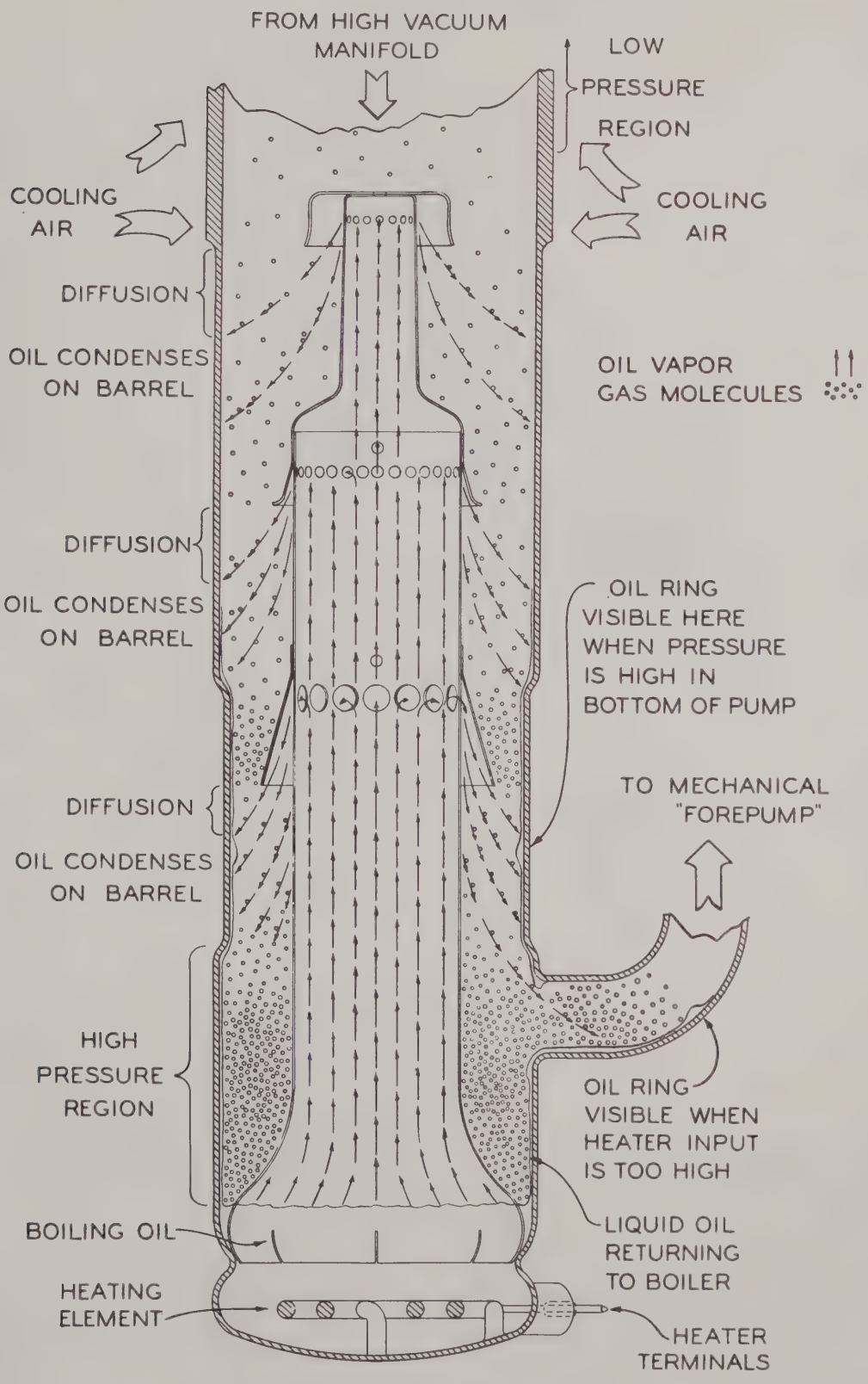
Increased pumping speed may be obtained by operating several HV-1 units in multiple. The number of units which may effectively be used in multiple will be determined by the ability of the forepump to produce the required forepressure, and the ability of the manifold and tubulations to handle the desired pumping speed.

The HV-1 is capable of reaching an ultimate vacuum of 4×10^{-7} mm of mercury or better when a liquid N_2 trap is used. To reach this low pressure, however, it is essential to avoid any contaminant in the high-vacuum system. Water, even in small amounts, or any hygroscopic matter should be carefully excluded. When so located as to be affected by heat, rubber is particularly objectionable, and a poor ultimate vacuum is likely to result if rubber gaskets are used in the diffusion pump. For this season, Neoprene gaskets are supplied with the HV-1.

In systems employing stop-cocks, valves or gaskets, it is necessary that the stop-cock, valve, or gasket lubricant have the minimum possible vapor pressure, because poor lubricants can easily destroy the high-vacuum capabilities of the pump.

APPLICATION

The HV-1 diffusion pump must be mounted securely, but not too rigidly. A satisfactory method of mounting consists of 1 X 1 X ⅛ inch angle shaped and drilled to pass four of the six spring loaded bolts used to join the large flanges at the top of the barrel (see illustration). When the desired manifold has been sealed to the manifold adapter (000914 on outline drawing), the pump is prepared for operation (after cleaning thoroughly as specified under **"CLEANING"**) in accordance with the following procedure:


FROM HIGH VACUUM MANIFOLD
LOW PRESSURE REGION
COOLING AIR
COOLING AIR
DIFFUSION
OIL CONDENSES ON BARREL
OIL VAPOR
GAS MOLECULES
DIFFUSION
OIL CONDENSES ON BARREL
OIL RING VISIBLE HERE WHEN PRESSURE IS HIGH IN BOTTOM OF PUMP
TO MECHANICAL "FOREPUMP"
DIFFUSION
OIL CONDENSES ON BARREL
HIGH PRESSURE REGION
OIL RING VISIBLE WHEN HEATER INPUT IS TOO HIGH
BOILING OIL
LIQUID OIL RETURNING TO BOILER
HEATING ELEMENT
HEATER TERMINALS

1. Pour 150 milliliters of Diffusion Pump Oil into the pump barrel (000917).
2. Insert the aluminum jet assembly (004911) into the pump barrel.
3. Assemble the pump carefully, moistening both sides of each gasket with pump oil, or with a very fine layer of heavy-grade "Celvacene," or equivalent grease.
4. Install the pump in its mounting.

IMPORTANT: DO NOT START DIFFUSION PUMP HEATER UNTIL FOREPUMP IS IN OPERATION AND SYSTEM IS FREE OF LEAKS.

5. After making certain that the forepump is connected to the nipple (008911) through the suitable flexible coupling (vacuum-hose or vacuum type bellows), start the forepump motor. Check the manifold with a Tesla or other high-voltage high-frequency spark coil for leaks BEFORE CONTINUING.

   The Tesla coil, with a flexible wire probe, may be used to indicate the presence of leaks above the baffle. It is also valuable in estimating pressure in the manifold during the early stages of evacuation. **CAUTION:** too high a voltage may puncture the manifold at its weak points, i.e., where the glass may be very thin or at a seal-off tubulation. A rough indication for a suitable Tesla voltage is that which will produce a corona of about one-eighth inch on the end of a No. 14 B & S probe wire, visible in the dark only, and a stringy spark not over five-eights inch to a grounded metal surface.

   If the system is known to be free of leaks, the forepump and HV-1 may be started together. However, to protect the system and its oil, the manifold first should be checked with the Tesla coil with the HV-1 "off." When the cold oil stops bubbling and the pink glow is seen to be diminishing at a normal rate, the system may be assumed to be reasonably tight and the HV-1 may be started.

6. Connect the oil heater terminals via a switch to the source of power. The oil heater voltage should be set to between 100 and 110 volts for best results. An adjustable resistor or an auto transformer of the tapped or continuously variable type is recommended. The current at 110 volts is approximately 1.7 amperes.

7. The baffle assembly and upper end of the pump barrel should be kept cool (35° C or lower) by a small fan or blower (see illustration).

OIL—The Eimac HV-1 is tested using a Silicon Oil, DC-704, to acquire the high-vacuum indicated in the specifications. DC-704 is water-white in color with a specific gravity of 1.07 at 25°C; it's flash-point is 410°F and the boiling point, for pressures of 5 to 10 microns of Hg, is 185°C. The ultimate vacuum attainable using DC-704 is on the order of 10^{-6} to 10^{-8} mm Hg. Although DC-704 is used to test the HV-1, any commercially available Diffusion Pump Oil, such as Narcoil, Octoil S, etc., is acceptable.

VACUUM GAGES—To properly monitor the vacuum conditions at the manifold, a sensitive gage in the desired range is necessary. There are many systems used for this purpose, one of the most sensitive in high-vacuum systems being the Ionization (or Ion) gage. Its useful range extends from approximately 5 microns to a region in the upper experimental vacuum limits on the order of 10^{-6} microns (5×10^{-3} to 10^{-9} mm Hg). Recently, tubes and circuits have been developed which contribute to the high stability of this instrument. The Eimac type 100IG Ion Gage tube is designed to give the maximum internal leakage path, thus avoiding erratic readings due to possible contamination from the system.

LEAKS—If the system does not "clean-up" in a reasonable time, considering the nature and size of the manifold and connected chambers, a leak may be looked for by means of the Tesla coil. The probe should be run over the entire surface of the glass work involved. A "fast" leak will be indicated where sparks concentrate at a point on the glass and a pinkish glow takes place within the evacuated space.

Where a slow leak is suspected, before "bake-out"[1] and where the vacuum is high but still not satisfactory, a solvent such as carbon tetrachloride may be applied to the manifold surface, but not to the Neoprene gaskets, with an atomizer, a wad of cotton or brush. If a leak is found, the Tesla voltage will cause a marked bluish glow while the solvent is entering the aperture, or the ion gage reading will indicate increased pressure.

After "bake-out" or when the manifold is too hot for the application of liquids, illuminating gas or hydrogen may be applied to the surface from an unlighted torch. Gas entering the hole will effect the ionization gage reading immediately. A very small leak may be found in this way. If there are no leaks, the manifold and pump assembly is ready for use[2].

With the manifold at high vacuum, no ionization will be apparent from the effects of a Tesla probe held on the manifold (above the baffle). Below the baffle on the barrel of the HV-1 pump, the probe will cause fluorescene of the oil vapors as well as a visible disturbance of the oil flow below the jets. The probe when touched to the HV-1 outlet will show a faint, blue-violet glow. If these first two conditions are obtained, but a pinkish glow is present in the outlet, the mechanical pump and its coupling should be checked.

For new oil, or after an oil change, approximately 15 minutes heating time is required for the HV-1 to reach full efficiency from a cold start.

PRECAUTIONS

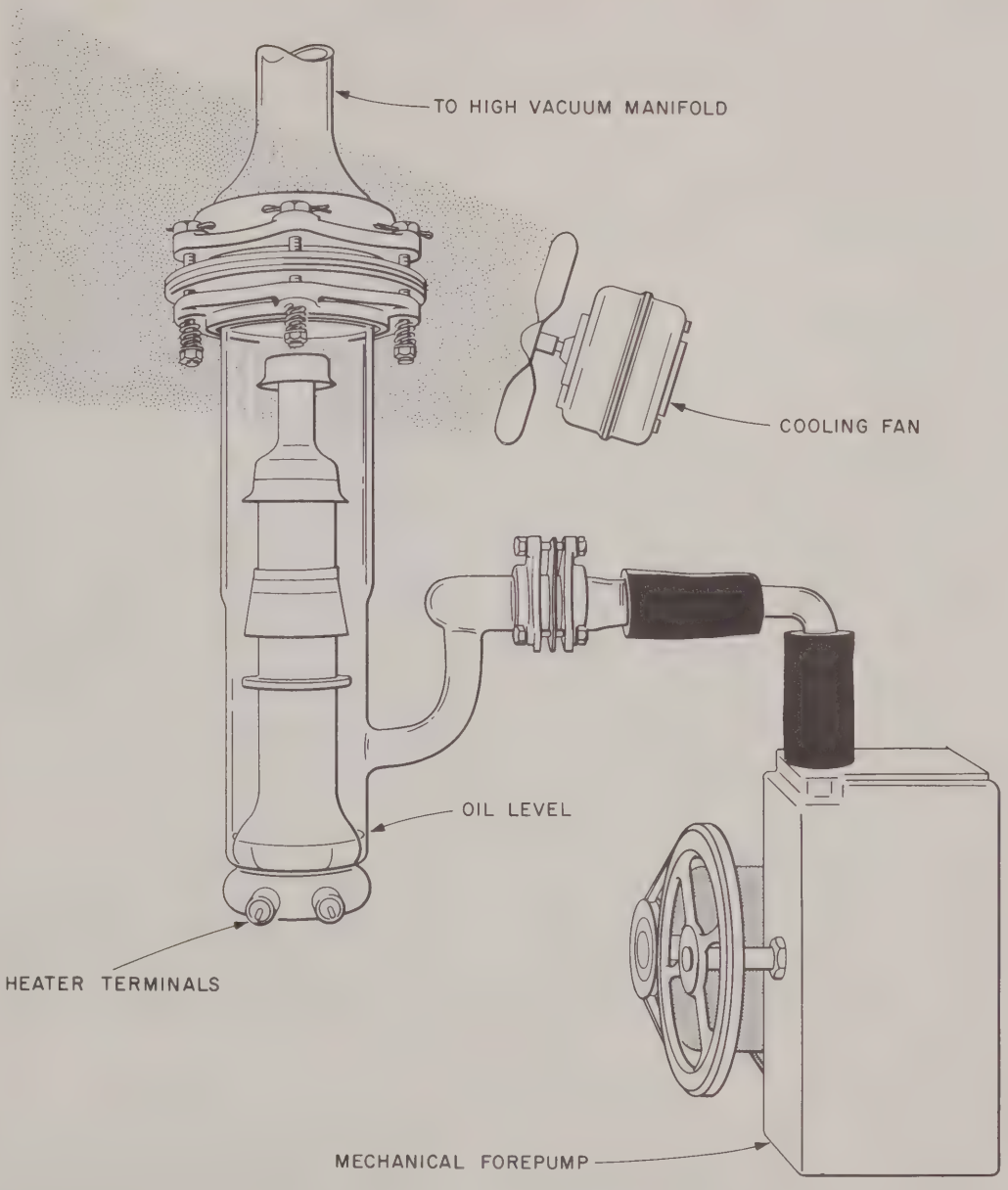
1. The vacuum system should not be opened "to air" when the diffusion pump is hot, to prevent oxidation of the pump oil.
2. If at any time a white vapor is visible in the HV-1, both pumps should be immediately shut off. The vapor is an indication of forepump failure or a very rapid leak. If the oil has become dark, the system may require complete cleaning.
3. Ground leads should be provided on both flange couplings to prevent the Tesla voltage from puncturing the Neoprene gaskets.

CLEANING

Diffusion pumps in continuous use should be cleaned at approximately one-month intervals. The materials and facilities required for cleaning are: Trichlorethylene and pentane (or acetone). An oven capable of temperatures up to 500° C will allow complete removal of carbonaceous deposits. The oven should be provided with an air inlet and outlet to allow the products of oxidation to be carried off. An accurate temperature control and indicator are advisable to prevent mishap to the glass parts. Where an oven is not available, steel wool, water and some abrasive cleanser, such as diatomaceous earth, may be used. The procedure is given in the following paragraphs.

1 "Bake-out" consists of surrounding the manifold and work to be evacuated with an oven. The temperature is then raised and held just under the annealing point for the "softest" glass being used in the system (approximately 500 degrees C for Pyrex). The temperature is maintained for thirty minutes to an hour, or at least until the new glass in the system shows no fluorescene on application of the Tesla voltage. This "cleans-up" the glass-ware to a point where it will not normally release further gas. An accurate thermocouple type temperature indicator and heater control are advisable to prevent mishaps to the system during "bake-out."

2 Contamination in the system such as decomposed oil, or a source of high vapor pressure in the load will give "virtual leaks" or unfavorable maximum vacuum readings.



GLASS HOUSING BARREL—New housings should be given a rinse with a cup of pentane or acetone and then warm-air dried. (CAUTION: pentane and acetone are inflammable. Keep away from open flames.) Used, dirty housings should have the excess of oil fluid rinsed out with two or three flushings of about one cup (per rinse) trichlorethylene. The last rinse may be saved for the first wash of the following pieces. To remove adhering carbonaceous matter after draining, the housing should be baked out in an oven up to 500° C. If the housing is not too caked, a rinse with pentane or acetone and gentle drying with warm air (in place of baking out in the oven) is sufficient.

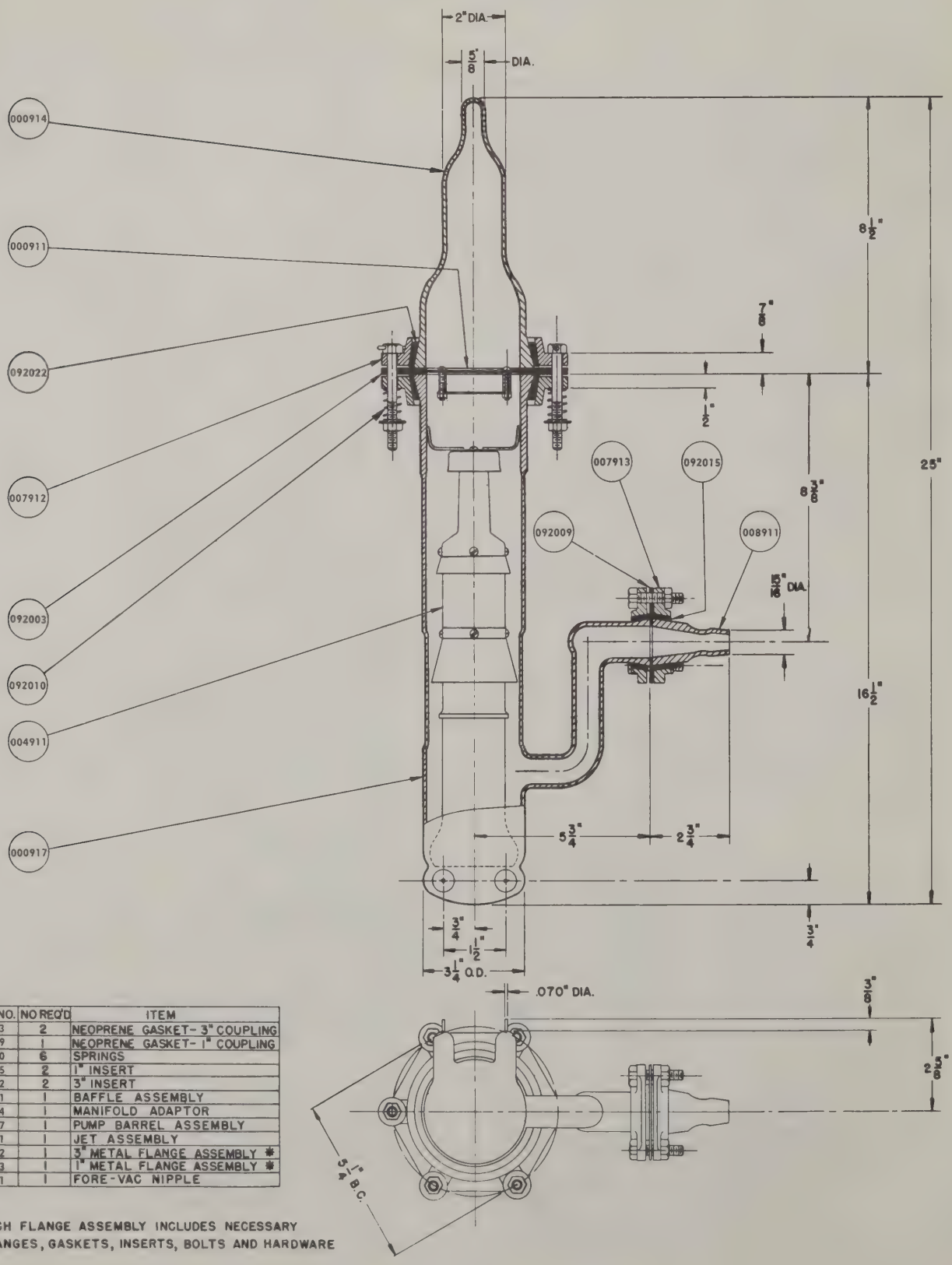
ALUMINUM JET ASSEMBLY—The jet assembly may be cleaned at the same time that the glass housing barrel is cleaned by inserting the assembly into the glass housing, pouring in the rinse solution and closing the top opening with a stopper. Agitate the solution by tilting and shaking the pump so that all parts are well washed over. Always remove the stopper and jet assembly after washing, prior to draining, baking or air drying. To further remove hard cabonaceous material, the assembly, less baffle, should be placed in an annealing oven and heated carefully to 475° C, then allowed to cool slowly in air.

BAFFLE—The baffle should be disassembled and all parts rinsed three times with pentane or acetone; the last two rinsings must be with clean solution. Follow with warm-air drying.

NEOPRENE GASKETS—Wash the gaskets in pentane or alcohol, warm-air dry, then dry in oven at 110° C for 30 minutes.

GLASS MANIFOLDS—Use the same procedure as for the glass housing barrel when feasible. However, usually washing with pure water and alcohol, followed by warm-air drying, may be sufficient because there is less formation of carbonaceous matter here than in the case of the pump housing.

EIMAC HV-1 DIFFUSION PUMP



PART NO.	NO REQ'D	ITEM
092003	2	NEOPRENE GASKET- 3" COUPLING
092009	1	NEOPRENE GASKET- 1" COUPLING
092010	6	SPRINGS
092015	2	1" INSERT
092022	2	3" INSERT
000911	1	BAFFLE ASSEMBLY
000914	1	MANIFOLD ADAPTOR
000917	1	PUMP BARREL ASSEMBLY
004911	1	JET ASSEMBLY
007912	1	3" METAL FLANGE ASSEMBLY *
007913	1	1" METAL FLANGE ASSEMBLY *
008911	1	FORE-VAC NIPPLE

* EACH FLANGE ASSEMBLY INCLUDES NECESSARY FLANGES, GASKETS, INSERTS, BOLTS AND HARDWARE

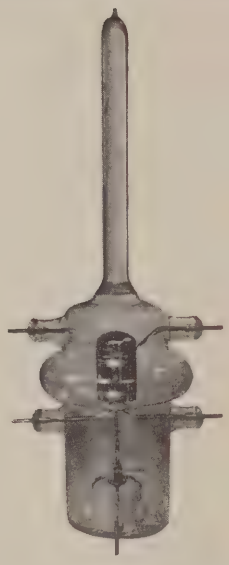
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EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

100 IG

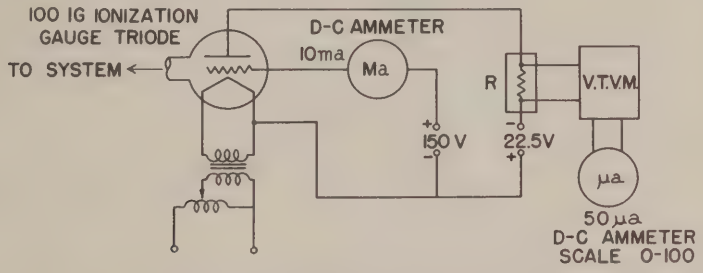
IONIZATION GAUGE TRIODE



The Eimac 100 IG ionization gauge is designed for use in high vacuum exhaust systems, and will measure pressures from approximately 10^{-3} millimeters of mercury to less than 10^{-8} millimeters of mercury. The Nonex glass envelope can be sealed directly to exhaust systems employing Nonex or Kovar-sealing glass and can be sealed to Pyrex by means of a graded seal.

The 100 IG is a triode vacuum tube consisting of a pure tungsten filament and molybdenum grid and plate. No insulators are used within the tube, and the envelope is designed to provide long leakage paths between the plate and other tube elements.

Positive ion current indications are obtained with either a sensitive galvanometer or a vacuum tube amplifier. A typical circuit employing an Eimac 100 IG ionization gauge triode and a vacuum tube voltmeter is shown below.



The filament temperature of the 100 IG must be low enough so that the emission is temperature-limited. With a good vacuum, the filament voltage will be between 2.0 and 4.0 volts, and the filament current will be approximately 8.0 amperes. With a poor vacuum, it will be necessary to increase the filament voltage to approximately 7.5 volts, and the current will be about 12 amperes. (The tube should not be operated long at high filament voltage.)

CAUTION: Filament voltage should not be applied until vacuum has been obtained as indicated by a spark coil glow test.

If grid voltage is obtained from a rectified a-c power supply and if the line voltage is not stable, it will be desirable to employ a gaseous regulator tube. A positive voltage of 150 volts with respect to the filament and current of 5 milliamperes is standard for the 100 IG.

The recommended plate voltage is -22.5 volts with respect to the filament. A plate voltage from -20 to -45 volts will give satisfactory operation, but plate voltages of 0 to -20 volts will result in low and incorrect plate currents.

In order to fully realize the capabilities of the 100 IG, it will be necessary to make "R" in the above figure variable. One circuit that has been employed with success is a group of 6 resistors and a rotary switch arranged so that only one resistor is across the input to the vacuum tube voltmeter at a time. By selecting resistors that increase by a factor of 10, the 0-100 scale microammeter will change calibration by the same factor, and will be convenient to read. With resistance values of 500, 5K, 50K, 500K, 5 megohms and 50 megohms, the maximum (full scale meter deflection) input voltage to the vacuum tube voltmeter will be ½ volt.

The calibration of the gauge depends upon the composition of the gas in the system. For dry air the pressure is given by the following formula:

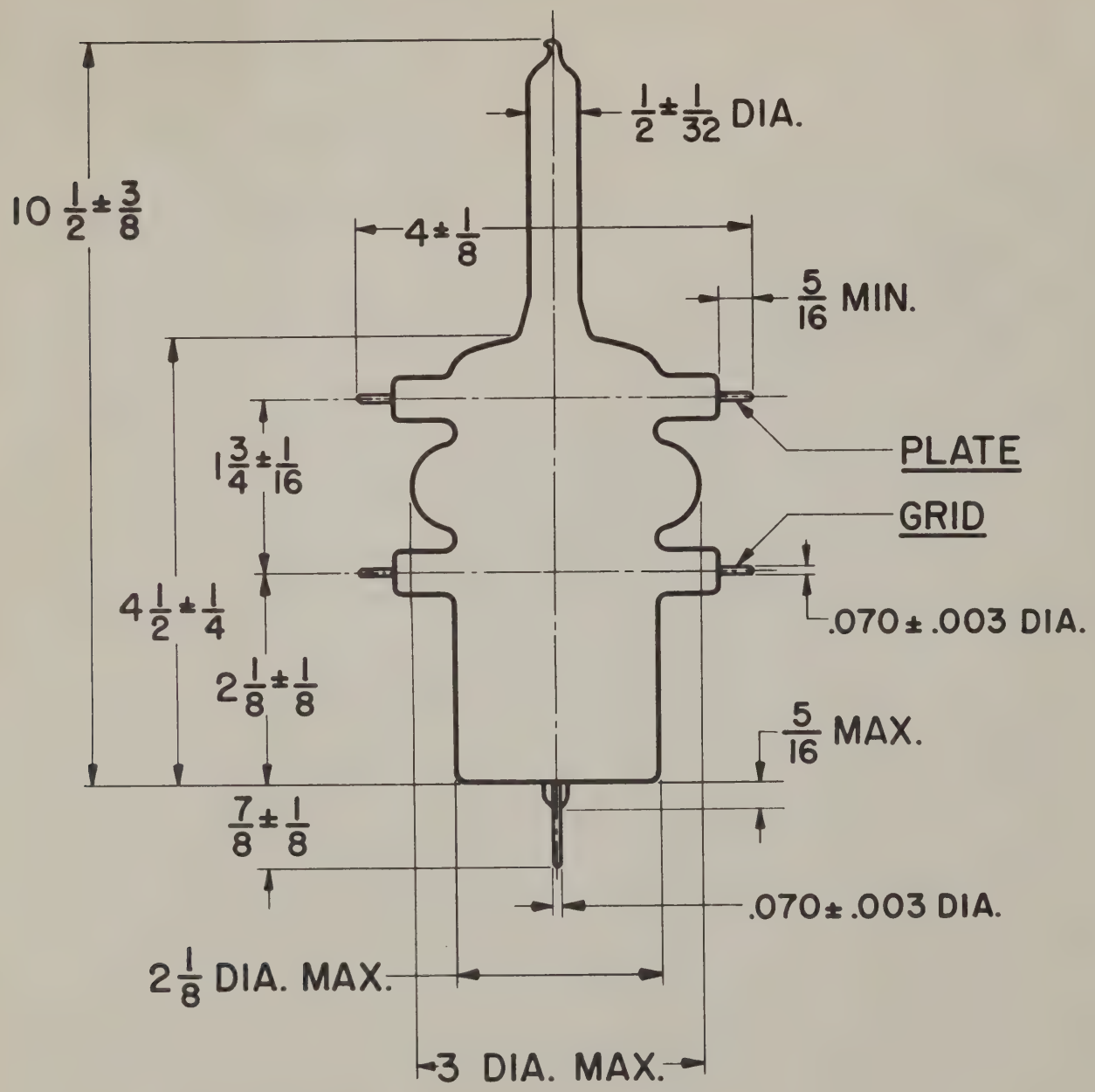
Pressure (mm. of Hg)	$= Ip\ (3.3 \times 10^{-5})$
where Ip	= Plate current in microamperes
when Grid Voltage .	= +150 volts
Grid Current . . .	= .005 amperes
Plate Voltage . .	= -22.5 volts

A bake-out of the tube at 450° Centigrade and outgassing of the tube elements is necessary whenever the exhaust system has been opened to air or the elements need cleaning. Outgassing is accomplished by heating the grid and plate to a dull cherry red by either r-f induction or by direct electron bombardment. Recommended outgassing voltages for the 100 IG are as follows:

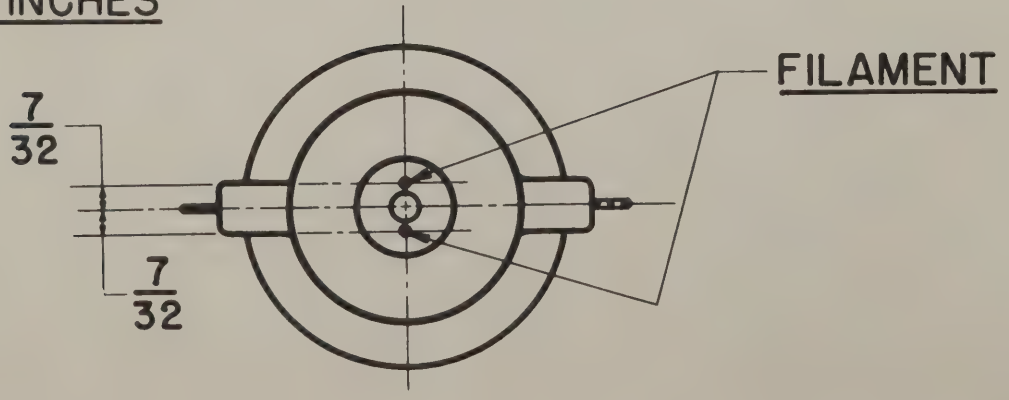
Filament Outgassing Voltage (approximately)	8 volts
Plate Outgassing Voltage	800 volts
Plate Outgassing Current	120 ma

The grid and a 1000 ohm resistor is placed in series with the plate during outgassing. The recommended outgassing time is approximately five minutes, or until the pressure in the exhaust system has become stabilized.

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DIMENSIONS
IN INCHES



Printed in U.S.A. I-70576

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA



PREFORMED CONTACT FINGER STOCK

Eimac Preformed Finger Stock is a prepared strip of spring material, slotted and formed into a series of fingers, designed to make a sliding contact.

Eimac Finger Stock provides excellent circuit continuity between components with adjustable or moving contact surfaces. It is especially suitable for making connections to tubes with coaxial terminals or to moving parts, such as long line and cavity circuits. It is also useful as an electrical "weather stripping" around access doors in equipment cabinets and "screen" rooms.

The base material is a non-ferrous spring alloy, heat treated for more positive spring action and silver plated for better r-f conductivity. No further forming of the material should be attempted. The minimum bending radius of curvature for the material is 0.75 inch. It may be secured by any suitable mechanical means or by soft soldering. If torch-soldering is attempted, extreme care must be exercised to prevent overheating which will anneal the material, resulting in loss of its elastic properties.

▶ Eimac Contact Finger Stock is heat treated to a minimum tensile strength of 170,000 pounds per square inch.

Eimac Contact Finger Stock is available (on special factory order) in the following semi-finished states:

CF-101 through CF-901: Slotted and formed (Not heat treated or plated)
CF-102 through CF-902: Slotted, formed, and heat treated (Not plated)
CF-103 through CF-903: Slotted, formed, and plated (Not heat treated)

Orders should allow approximately ninety days for completion since these semi-finished materials are not carried in stock.

Contact Finger Stock which has not been heat treated can be formed to different shapes by the user, after which it may be heat treated. Eitel-McCullough can not undertake heat treatment or plating of semi-finished Contact Finger Stock after it has been further formed by a customer.

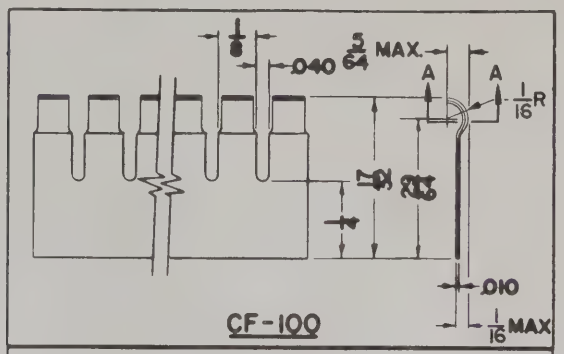
A suitable heat treating schedule consists of holding the unplated material at 600° ± 5° F for 2.5 hours in air, after which it must be cleaned and plated. Heat treating the material in a controlled atmosphere such as cracked natural gas, disassociated ammonia, or forming gas will minimize oxidation. Finger stock should be held in a suitable jig or fixture during heat treating to prevent deformation.

▶ CF-100, CF-700, and CF-800 incorporate "spooned" fingers to prevent scratching the contact surface (see drawings on reverse side of sheet).

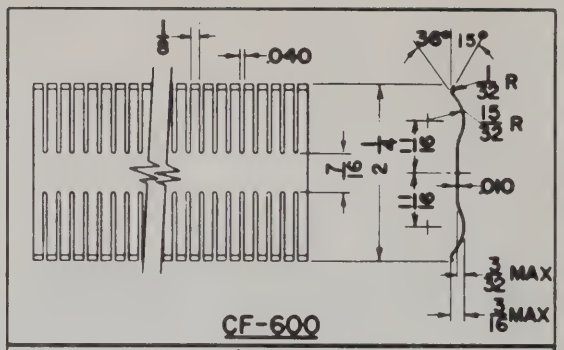
Eimac Contact Finger Stock is supplied in 36 inch lengths.

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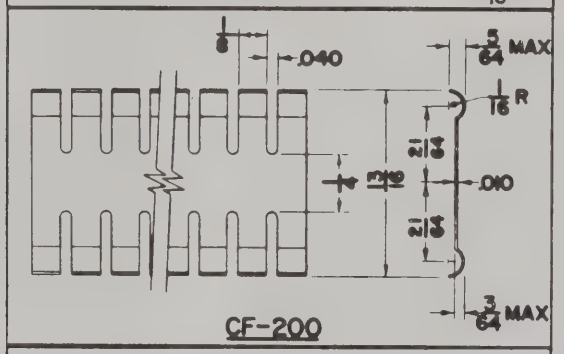
▶ Indicates change from sheet dated 3-17-59



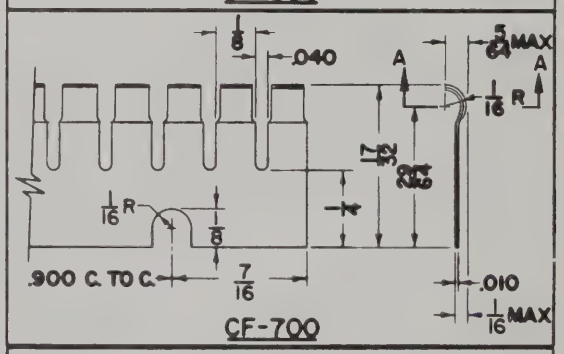
CF-100



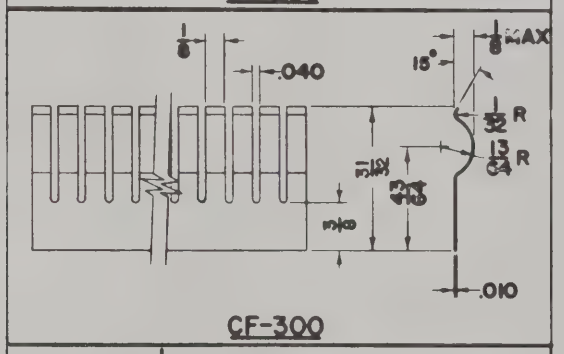
CF-600



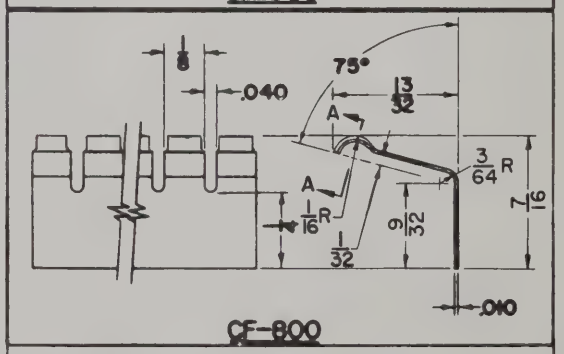
CF-200



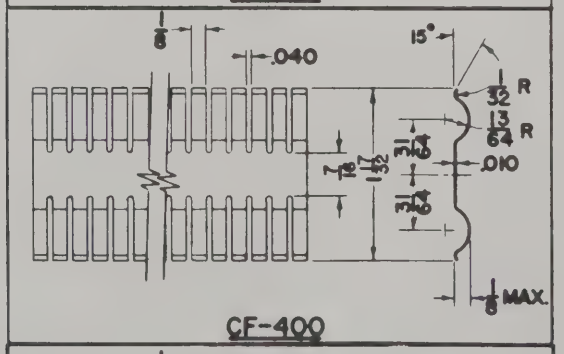
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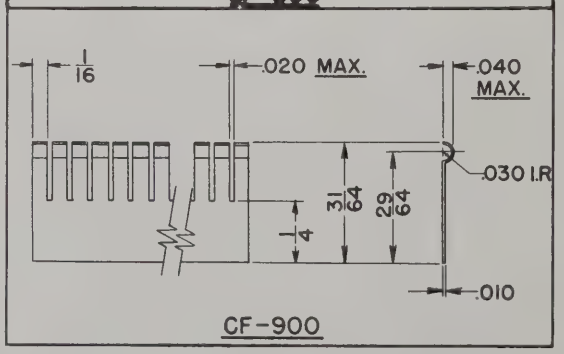
CF-300



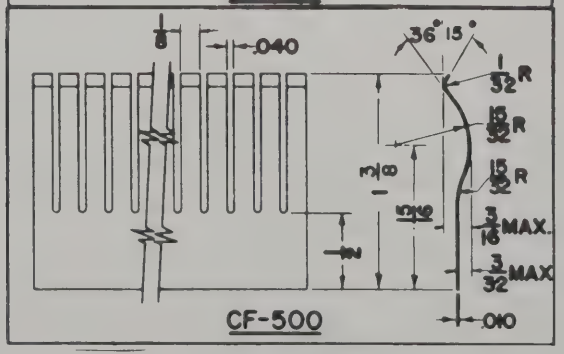
CF-800



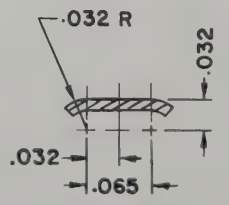
CF-400



CF-900



CF-500



SECTION A-A
(CF-100, 700, 800)

NOTE—The above dimensions should be regarded as carrying normal manufacturing tolerances because of variations in the shearing, forming and heat-treating processes.

▶ Indicates change from sheet dated 3-17-59

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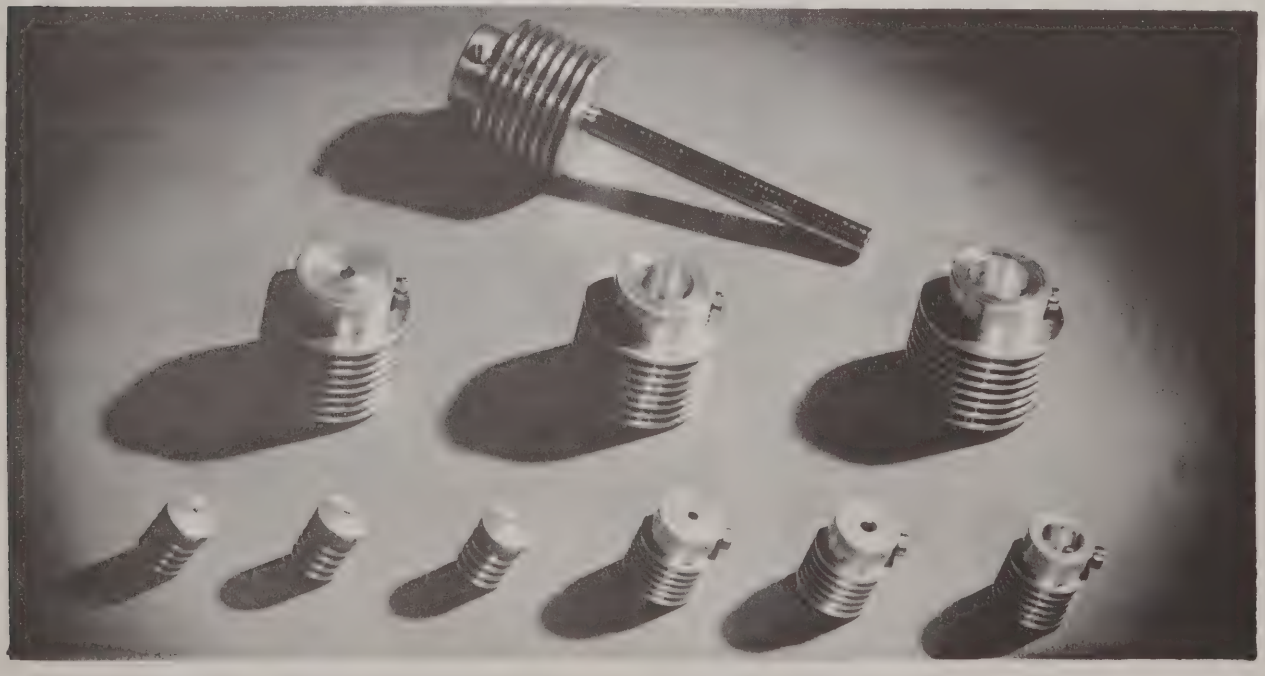
HR HEAT DISSIPATING CONNECTORS

Eimac HR Heat-Dissipating Connectors are used to make electrical connections to the plate and grid terminals of Eimac tubes, and, at the same time, provide efficient heat transfer from the tube element and glass seal to the air. The HR connectors aid materially in keeping seal temperatures at safe values. However, it is sometimes necessary to forced-air cool the connector by means of a small fan or blower. In such cases the air flow should be parallel with the fins of the connector. Designed for use on the larger tubes, the HR-9 Heat-Dissipating Connector is provided with an air duct to conduct the cooling air directly to the glass seal.

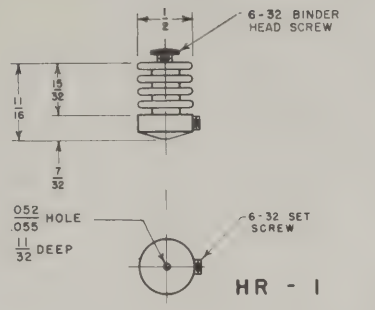
HR Heat-Dissipating Connectors are machined from solid dural rod, and are supplied with the necessary machine screws. The table below lists the proper connectors for use with each Eimac tube type.

TUBE	PLATE CONNECTOR	GRID CONNECTOR	TUBE	PLATE CONNECTOR	GRID CONNECTOR
2-25A	HR-1	.....	75TH-TL	HR-3	HR-2
2-50A	HR-3	.....	100R	HR-8	.....
2-150D	HR-6	.....	100TH-TL	HR-6	HR-2
2-240A	HR-6	.....	VT127A	HR-3	HR-3
2-2000A	HR-8	.....	152TH-TL	HR-5	HR-6
3C24	HR-1	HR-1	250TH-TL	HR-6	HR-3
4-65A	HR-6	.....	250R	HR-6	.....
4-125A	HR-6	.....	253	HR-8	.....
4-250A	HR-6	.....	304TH-TL	HR-7	HR-6
4-400A	HR-6	.....	327A	HR-4	HR-3
4-1000A	HR-8	.....	450TH-TL	HR-8	HR-8*
4E27A/5-125B	HR-5	.....	592/3-200A3	HR-10	HR-5
4PR60A	HR-8	.....			
6C21	HR-8	HR-8			
KY21A	HR-3	.....	750TL	HR-8	HR-8
RX21A	HR-3	.....	866A	HR-8	.....
25T	HR-1	.....	872A	HR-8	.....
35T	HR-3	.....	1000T	HR-9	HR-9
35TG	HR-3	HR-3	1500T	HR-8	HR-8
UH50	HR-2	HR-2	2000T	HR-8	HR-8

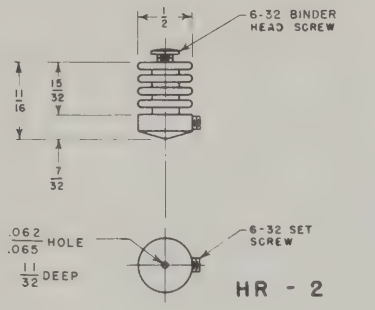
*The grid terminal of the 450TH-TL type tube is now .563" in diameter. To accommodate existing equipment designed for the older style 450TH-TL having .098" diameter grid terminals, an adapter pin is provided with the newer tubes. This adapter pin is threaded so that it may be removed from the grid terminal of the tube. The small grid terminal requires an HR-4 connector.



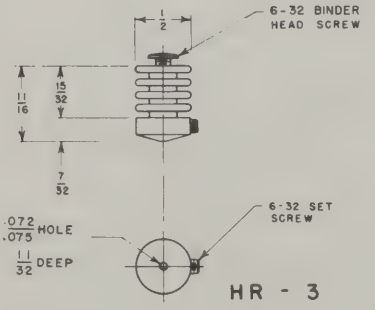
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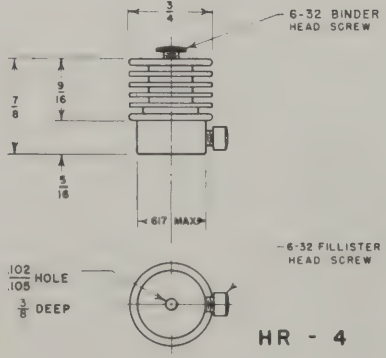
HR - 1



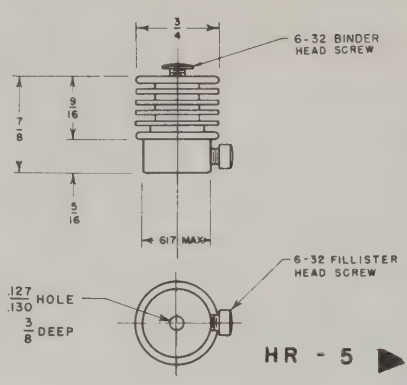
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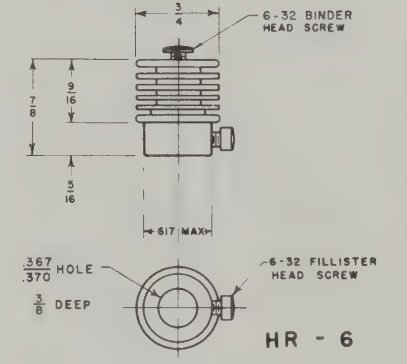
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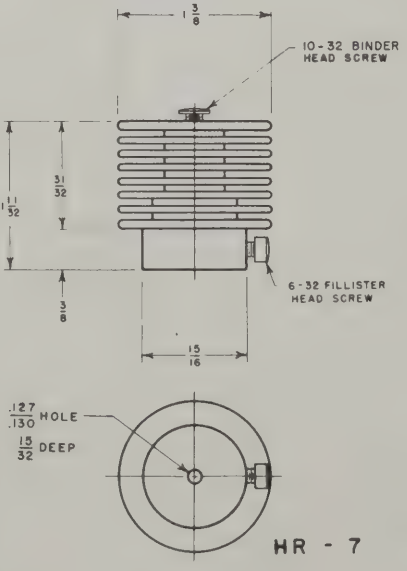
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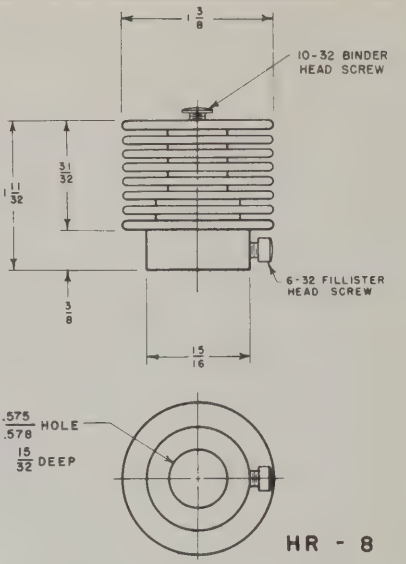
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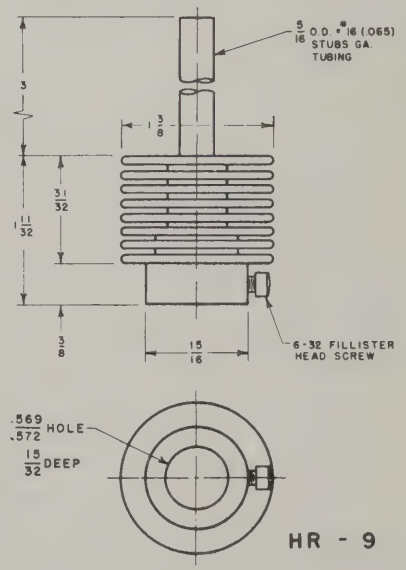
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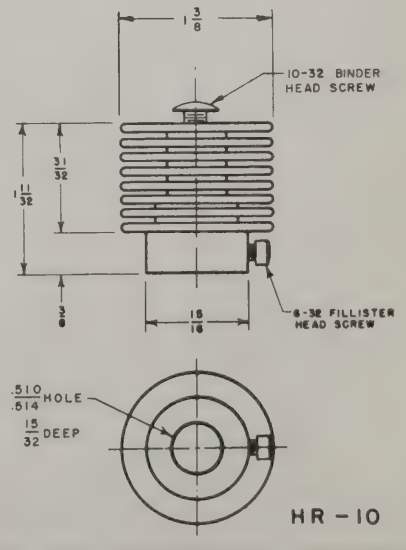
HR - 7



HR - 8



HR - 9



HR - 10

▶ Indicates change from sheet dated 10-15-54

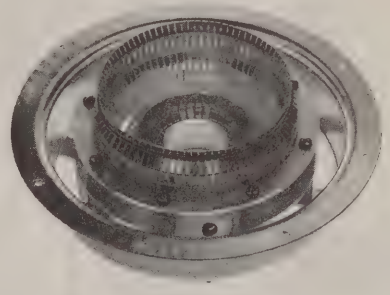
Eimac

EITEL-McCULLOUGH, INC.

SK-300

AIR-SYSTEM SOCKET

The Eimac SK-300 Air-System Socket is recommended for use with those tube types listed at the bottom of the data sheet. The Eimac SK-306, SK-316 and SK-1306 Air Chimneys are available for use with this socket. When this socket is used, connection is made to each of the tube electrodes, except the anode, by means of concentric rings of spring-finger contacts. The SK-300 is humidity and salt-spray resistant.



BASE CONNECTION

The SK-300 Air-System Socket consists of four concentric rings of spring-finger contacts. The socket is provided with two filament connectors with a ¼" diameter hole in each connector for making connection to the inner and outer filament contacts, one 6-32 terminal is provided for connecting to the screen-grid. The SK-300 has four 8-32 terminals for connecting to the control-grid. The four contact rings are shown on the outline drawing.

MATERIALS AND FINISHES

The socket body is made from silver-plated brass. The contact material is a non-ferrous spring alloy, beryllium-copper, per QQ-C-533, heat treated for spring action and silver-plated, per QQ-S-365, for good RF conductivity. The insulation material is teflon and rexolite.

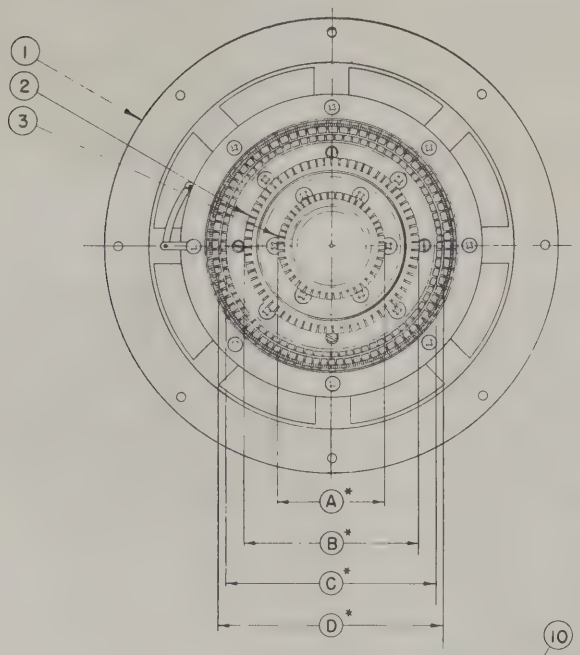
INSTALLATION

The SK-300 Air-System Socket can be mounted on a chassis deck, partition or pressurized compartments. Chassis mounting is accomplished by cutting a 6¾" hole in the chassis deck or partition. The socket is then placed in the hole and fastened in place by eight 6-32 machine screws through the eight holes provided for fastening. The SK-306, SK-316 and SK-1306 chimneys can also be mounted by these same eight screws. **The SK-300 Air-System Socket is recommended for use with the following tubes:**

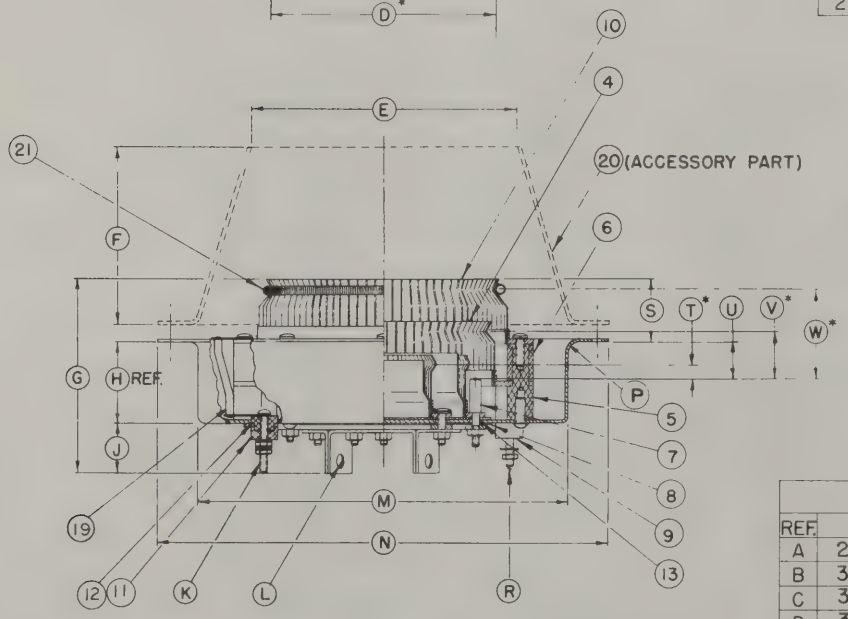
8170/4CX5000A	8171/4CX10,000D
4CW10,000A	8281/4CX15,000A

Net Weight - - - - - - - - - - - - - - - - - - SK-300 3.75 lbs.

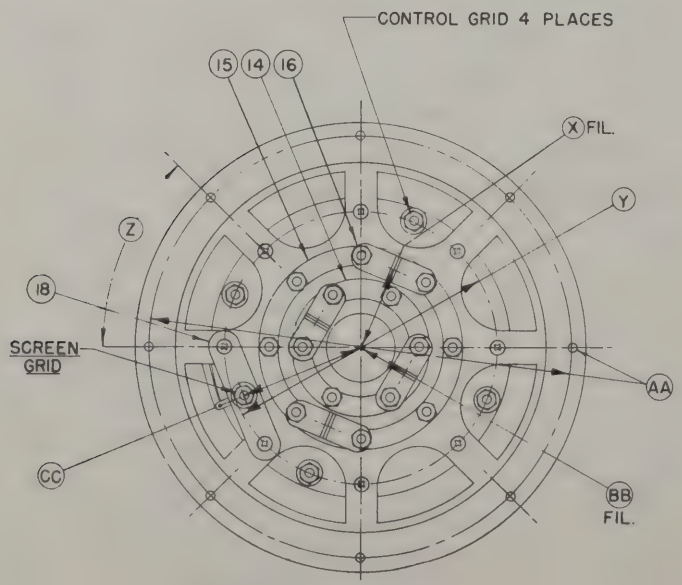
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NO.	PART NO.	DESCRIPTION
1	001821	SOCKET CUP
2	001838	OUTER FIL. COLLET
3	001837	INNER FIL. COLLET
4	001839	CONTROL GRID COLLET
5	001823	POST INSULATOR
6	001813	SLEEVE INSULATOR
7	001825	STOP POST
8	001820	INSULATOR-FIL. COLLET
9	001829	CONTROL GRID CONN.
10	001840	SCREEN GRID COLLET
11	001835	CAP
12	001836	BODY
13	001834	INSULATOR WASHER
14	001808	INNER FIL. BUSS RING
15	001809	OUTER FIL. BUSS RING
16	115782	FILAMENT CONNECTOR
17		
18	001807	BRACKET
19	115317	SCREEN CONTACT CON ASSY
20	001812	SK-306 AIR DUCT CONE
21	001870	SPRING



NOTES:
1. ALL DIMENSIONS IN INCHES
2. TOLERENCES ARE NOT CUMULATIVE
3. *CONTACT SURFACES



DIMENSION DATA			
REF.	MAX.	MIN.	NOM.
A	2.061 DIA.	2.001 DIA.	
B	3.311 DIA.	3.251 DIA.	
C	3.732 DIA.	3.672 DIA.	
D	3.940 DIA.	3.880 DIA.	
E	4.921 DIA.	4.890 DIA.	
F	3.531	3.469	
G	3.581	3.434	
H	1.516 REF.	1.461 REF.	
J	.925	.863	
K	#6-32 NC 2A, STUD		
L	.265 DIA.	.235 DIA.	
M	6.766 DIA.		
N	8.266 DIA.		
P	.187 R.		
R	#8-32 NC 2A STUD		
S	1.140	1.110	
T	.240	.216	
U	.689	.655	
V	.856	.826	
W	1.657	1.595	
X	1.577	1.547	
Y	5.015 DIA. P.C.	4.985 DIA. P.C.	
Z			45° REF.
AA	.147 DIA. 8 HOLES ON 7 3/4 DIA. P.C.		
BB	.952	.922	
CC	2.327	2.297	

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

SK-400

AIR-SYSTEM SOCKET



The SK-400 Air-System Socket is the recommended socket for use with the 4-400A tetrode, and it may be used as well with 4-250A, 4-125A and other tubes having the same physical dimensions. The SK-400 provides efficient connection between the tube and its external circuits, acts as a firm mechanical support for the tube, and controls the flow of cooling air around the tube envelope.

The SK-400 Air-System Socket consists of a cast aluminum body, which supports the electrical insulation for the terminals and acts as an air-duct to guide the air flow into the base of the tube. The air passes through the base of the tube and is guided past the tube envelope and plate seal by the Air-Chimney SK-406.

Most applications of the SK-400 Air-System Socket require the use of the SK-406 Air Chimney to guide the air over the envelope of the tube and past the plate seal. The SK-406 Air Chimney may be omitted only in the few special cases where other provisions for cooling the tube envelope and plate seal are made.

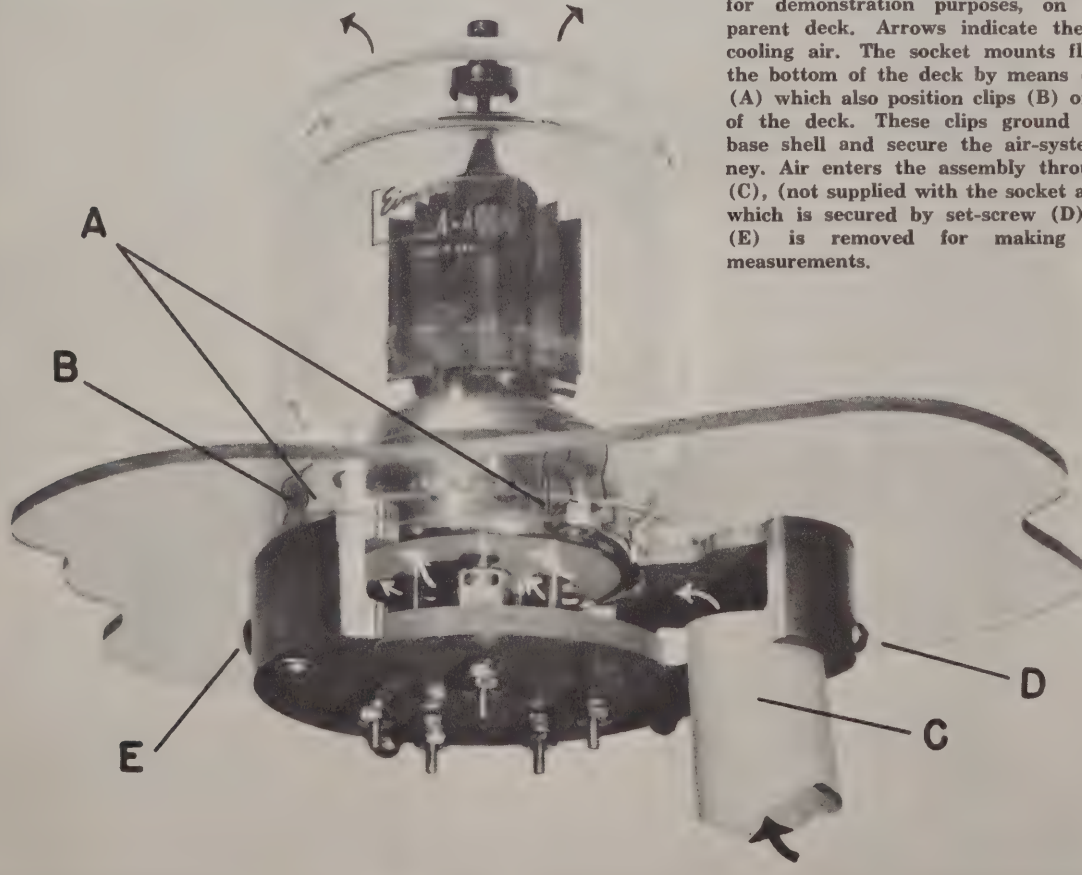
The electrical insulation for the connecting jacks and their terminals is a disk of low-loss insulating material, resting on a shoulder turned into the bottom of the socket body. The insulating disk is held in place by four machine screws which act as clamps. The design permits the insulation and terminal assembly to be rotated to any convenient direction and clamped firmly in place, so that no compromise with wiring requirements will have to be made when the socket is installed.

An air blower must be connected to the socket air-inlet. This can be done by means of a duct terminating in a cylindrical fitting of 1¼ inches O.D., or the chassis may be enclosed and connected to the blower. In either case, the pressure drops and corresponding flow-rates will depend upon the tube type, power level, operating frequency and ambient conditions, and must be obtained from the data sheet for the tube in use.

Socket air pressure can be measured conveniently by a manometer arranged to indicate the pressure difference between the air in the socket and the air in its surroundings. To facilitate and standardize this measurement, a ¼-28-threaded hole is provided in the wall of the socket opposite the air inlet. A probe or fitting can be screwed into this hole for connection to a manometer; it should be screwed into the socket until its end is flush with the inner wall of the socket base. It should not be permitted to protrude inside the inner wall of the socket.

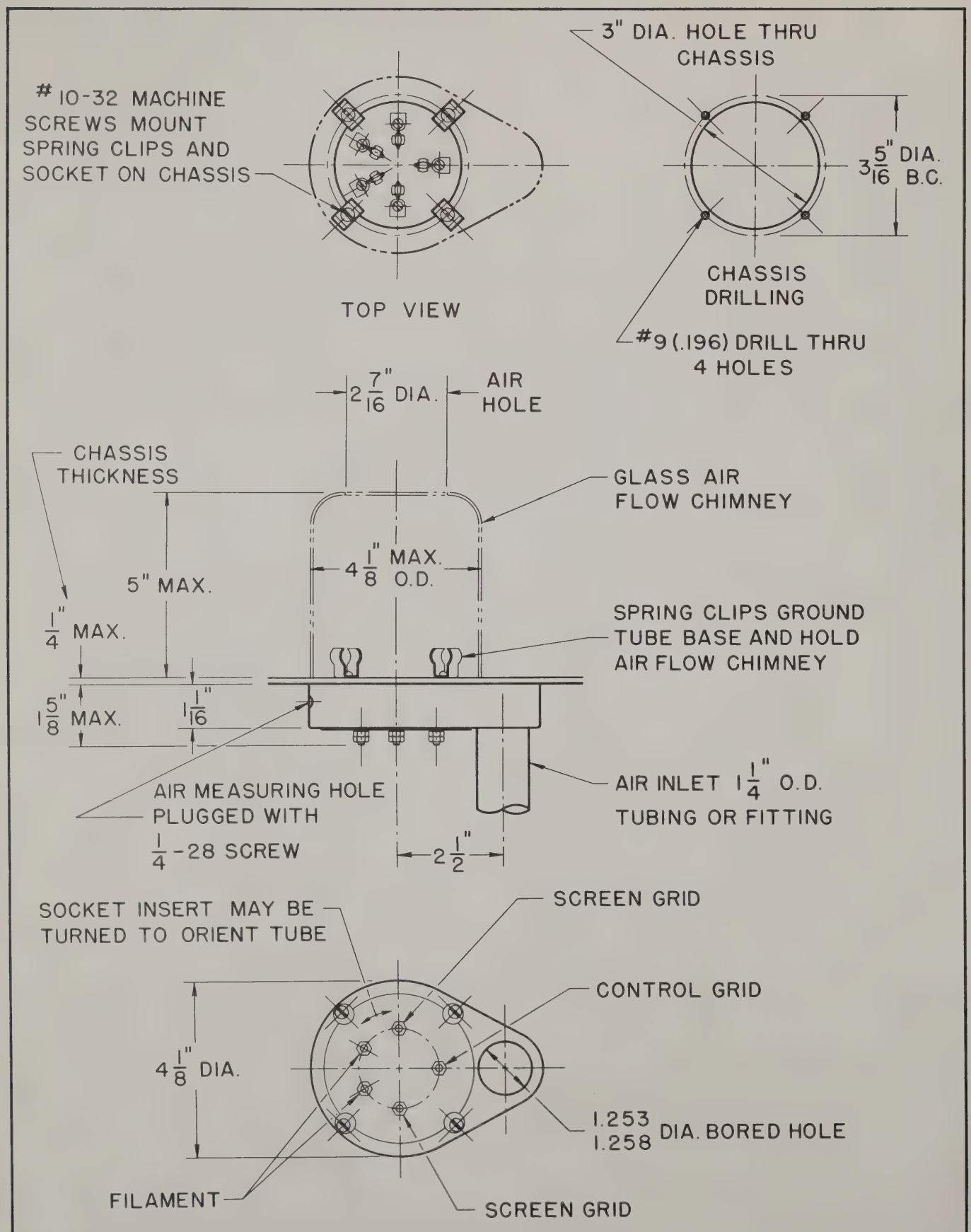
The SK-400 Air-System Socket is designed for under-chassis mounting and requires a three-inch diameter hole through the chassis deck. The socket is fastened in place by four 10-32 machine screws, running in tapped holes in the cast aluminum socket body. These four screws also hold four small, double clips which serve to hold the SK-406 Air-Chimney in place.

When a tube is inserted in the socket, the five pins on the tube base are engaged by five self-aligning pin jacks in the socket. The connecting leads to the socket must be sufficiently flexible to permit free movement of the pin-jacks, or the self-aligning feature may be impaired.



Looking up at a cut-away socket mounted, for demonstration purposes, on a transparent deck. Arrows indicate the flow of cooling air. The socket mounts flush with the bottom of the deck by means of screws (A) which also position clips (B) on the top of the deck. These clips ground the tube base shell and secure the air-system chimney. Air enters the assembly through duct (C), (not supplied with the socket assembly) which is secured by set-screw (D). Screw (E) is removed for making pressure measurements.

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Eimac

EITEL-McCULLOUGH, INC.

SK-406
SK-416

AIR-SYSTEM CHIMNEYS



The SK-406 and SK-416 Air-System Chimneys are intended for use with those tube and socket combinations listed below. They are used to direct cooling air from the socket across the glass envelope of the tube, past the plate seal and heat-radiating connector.

MATERIALS

The SK-406 and SK-416 Air-System Chimneys are made of sturdy, heat resistant Pyrex glass. The bottom edge is flat for a tight seal against the chassis while the top edge has been fired for smoothness.

INSTALLATION

These chimneys are designed for installation above the chassis or plenum that holds the companion Air-System Socket. The four spring clips supplied with the SK-400 (eight clips are supplied with the SK-410) socket also act as retaining clips for the chimney. After the socket and spring clips are installed, the chimney is pressed down over the spring clips.

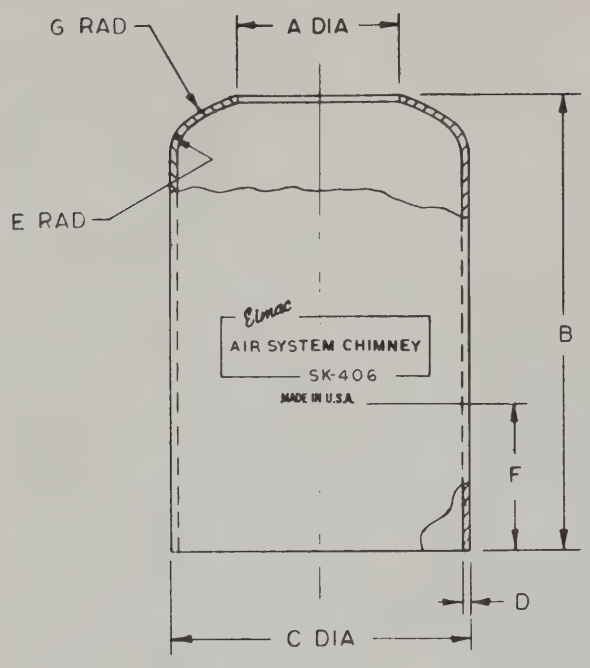
CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	TUBE	SOCKET
SK-406	4-125A 4-250A 4-400A 4PR125A 4PR400A	SK-400 SK-410
SK-416	3-400Z	

Net Weight - - - - - - - - SK-406 - 8 ounces

SK-416 - 7 ounces

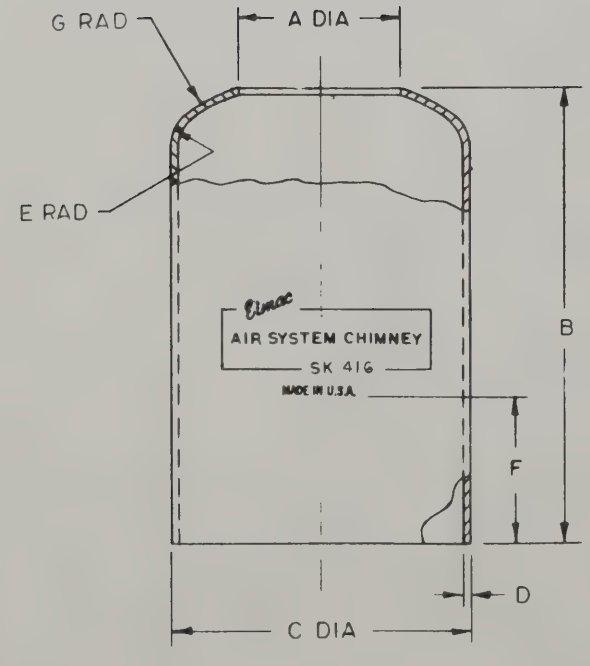
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DIMENSIONAL DATA			
REF	MIN	MAX	NOM.
A	2.312	2.437	
B	4.687	4.875	
C	3.750	3.875	
D	.060	.090	
E	.125	.375	
F	1.625	1.875	
G	3.125	3.375	

MAT'L: PYREX

SK-406



DIMENSIONAL DATA			
REF	MIN.	MAX	NOM.
A	2.312	2.437	
B	3.593	3.781	
C	4.015	4.125	
D	.060	.090	
E	.125	.375	
F	1.187	1.312	
G	3.125	3.375	

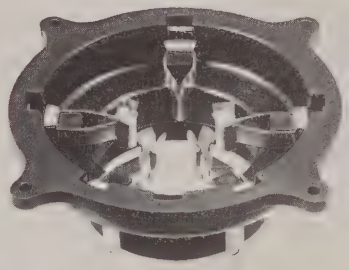
MAT'L: PYREX

SK-416

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

SK-410

AIR-SYSTEM SOCKET



The Eimac SK-410 is one of the Air-System Sockets recommended for use with those tube types listed at the bottom of the data sheet or other tube types having the same special five-pin base. Two glass Air-Chimneys are available for use with this socket depending upon the tube type used. The SK-406 Air-Chimney is recommended for use with tube types 4-250A, 4-400A, 4PR250C, and 4PR400A and the SK-416 Air-Chimney with the 3-400Z. When this socket is used, connection is made to each of the tube electrodes, except the anode. The SK-410 is humidity and salt-spray resistant.

BASE CONNECTIONS

The SK-410 Air-System Socket consists of five base pin contacting terminals. The terminals are shown on the outline drawing. Four special grounding clips are provided for use with tubes which incorporate metal base shells. It is recommended that these clips be used to prevent the build up of large potentials on the metal shell.

MATERIALS AND FINISHES

The shell or body of the socket is mepa-phthalate, per Mil-M-19833. The base contact terminals are fabricated of beryllium-copper, per QQ-C-533, heat treated after forming, then silver-plated, per QQ-S-365. Eight clips are provided for gounding the metal base shell and holding the Air-Chimney.. They are fabricated of beryllium-copper, heat-treated after forming, then cadmium-plated, per QQ-P-416.

NET WEIGHT - - - - - - - - - - - - - - - - - - 5.5 ounces

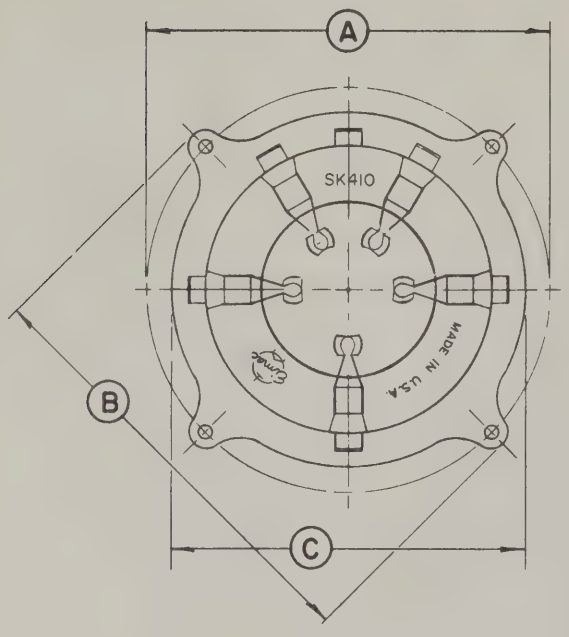
INSTALLATION

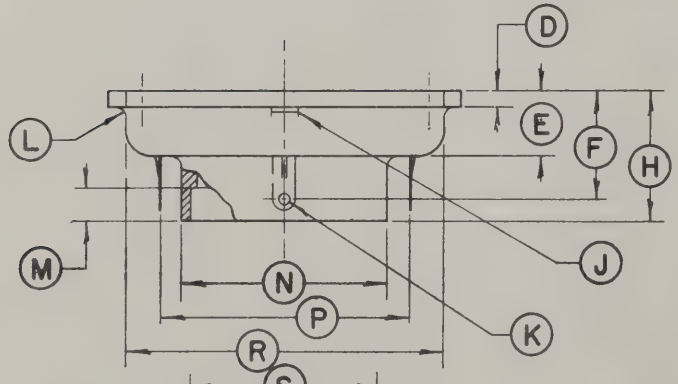
The SK-410 Air-System Socket can be mounted on a chassis deck, partitions or pressurized compartments. Chassis mounting is accomplished by cutting a 2-5/8" hole in the chassis deck or partition. The socket is then placed in the hole and fastened in place by four 6-32 machine screws through the four screw holes provided for fastening. This socket has a 2-3/8" O.D. round neck extending 3/4" below the main socket body which provides means for connecting any standard type air-duct to the base. Four additional clips are provided for holding the Air-Chimney. The SK-410 Air-System Socket is recommended for use with the following tube types:

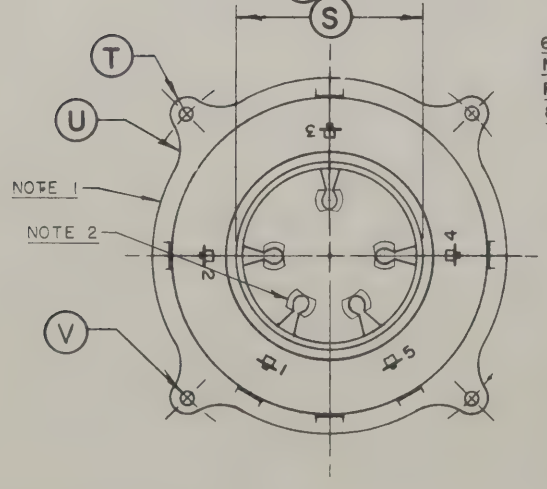
3-400Z	4-400A	4PR250C
4-250A	4PR400A	

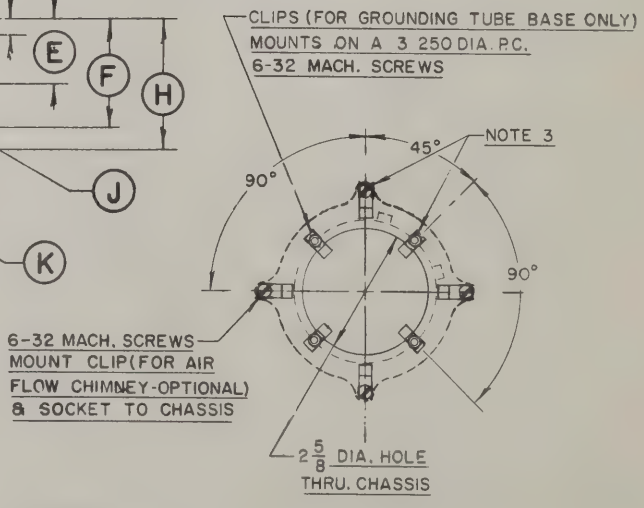
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DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	$4\frac{19}{32}$ DIA.B.C.	$4\frac{21}{32}$ DIA.B.C.	
B	$4\frac{31}{32}$	$5\frac{1}{32}$	
C	$4\frac{1}{32}$ DIA.	$4\frac{3}{32}$ DIA.	
D	$\frac{5}{32}$	$\frac{7}{32}$	
E	$\frac{23}{32}$	$\frac{25}{32}$	
F	$1\frac{7}{32}$	$1\frac{9}{32}$	
H	$1\frac{15}{32}$	$1\frac{17}{32}$	
J	$\frac{1}{32}$ X $\frac{9}{32}$	$\frac{3}{32}$ X $\frac{11}{32}$	
K	$\frac{3}{32}$ DIA.	$\frac{5}{32}$ DIA.	
L	$\frac{3}{32}$ R.	$\frac{5}{32}$ R.	
M	$\frac{11}{32}$	$\frac{13}{32}$	
N	$2\frac{11}{32}$ DIA.	$2\frac{13}{32}$ DIA.	
P	$2\frac{27}{32}$	$2\frac{15}{16}$	
R	$3\frac{19}{32}$ DIA.	$3\frac{21}{32}$ DIA.	
S	$2\frac{9}{64}$ DIA.	$2\frac{13}{64}$ DIA.	
T	$\frac{5}{32}$ R.	$\frac{7}{32}$ R.	
U	$\frac{15}{32}$ R.	$\frac{17}{32}$ R.	
V	.139 DIA.	.152 DIA.	









NOTES:

1. SOCKET SHELL-MAT'L: DIALLYL PHTHALATE.
2. CONTACT CLIPS-MAT'L: BERYLLIUM COPPER PER QQ-C-533
   FINISH: SILVER PLATED PER EIMAC SPEC. 016011
3. CLIPS – PART Nº 115846N PER DWG. 115842

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

SK-500

AIR-SYSTEM SOCKET AND CHIMNEY



The SK-500 Air-System Socket is the recommended socket for use with the 4-1000A tetrode, and it may be used as well with any other tubes having the same physical dimensions. The SK-500 provides efficient connection between the tube and its external circuits, acts as a firm mechanical support for the tube, and controls the flow of cooling air around the tube envelope.

The SK-500 Air-System Socket consists of a cast aluminum body, which supports the electrical insulation for the terminals and acts as an air-duct to guide the air flow into the base of the tube. The air passes through the base of the tube and is guided past the tube envelope and plate seal by the glass Air Chimney, SK-506.

Most applications of the SK-500 Air-System Socket require the use of the SK-506 Air Chimney to guide the air over the envelope of the tube and past the plate seal. The SK-506 Air Chimney may be omitted only in the few special cases where other definite provisions for cooling the tube envelope and plate seal have been made.

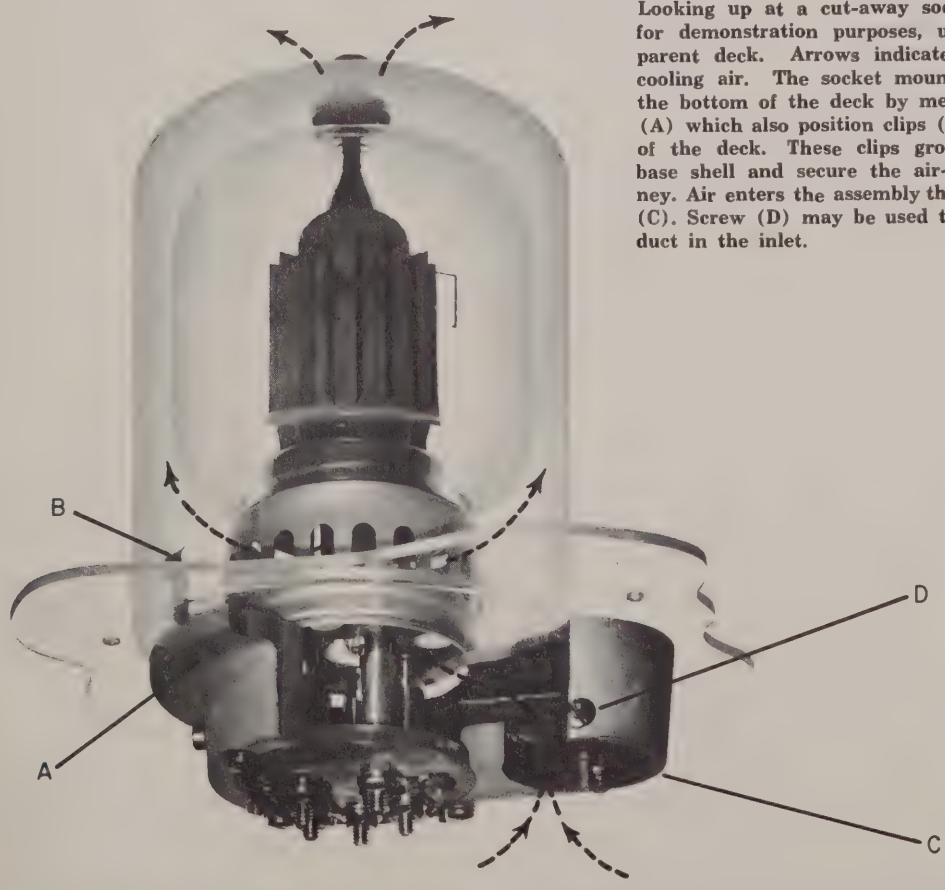
The electrical insulation for the connecting jacks and their terminals is a disk of low-loss insulating material, resting on a shoulder turned into the bottom of the socket body. The insulating disk is held in place by four machine screws which act as clamps. The design permits the insulation and terminal assembly to be rotated to any convenient direction and clamped firmly in place, so no compromise with wiring requirements will have to be made when the socket is installed.

An air blower must be connected to the socket air-inlet. This can be done by means of a duct terminating in a cylindrical fitting of two inches O.D., or the chassis may be enclosed and connected to the blower. In either case the pressure drops and corresponding flow-rates will depend upon the tube type, power level, operating frequency and ambient conditions, and must be obtained from the data sheet for the specific tube type being used.

Socket air pressure can be measured conveniently by a manometer arranged to indicate the pressure difference between the air in the socket and the air in its surroundings. To facilitate and standardize this measurement, 1/4-28-threaded hole is provided in the wall of the socket body opposite the air inlet. A probe or fitting can be screwed into this hole for connection to a manometer; it should be screwed into the socket until its end is flush with the inner wall of the socket base. It should not be permitted to protrude inside the inner surface of the socket wall.

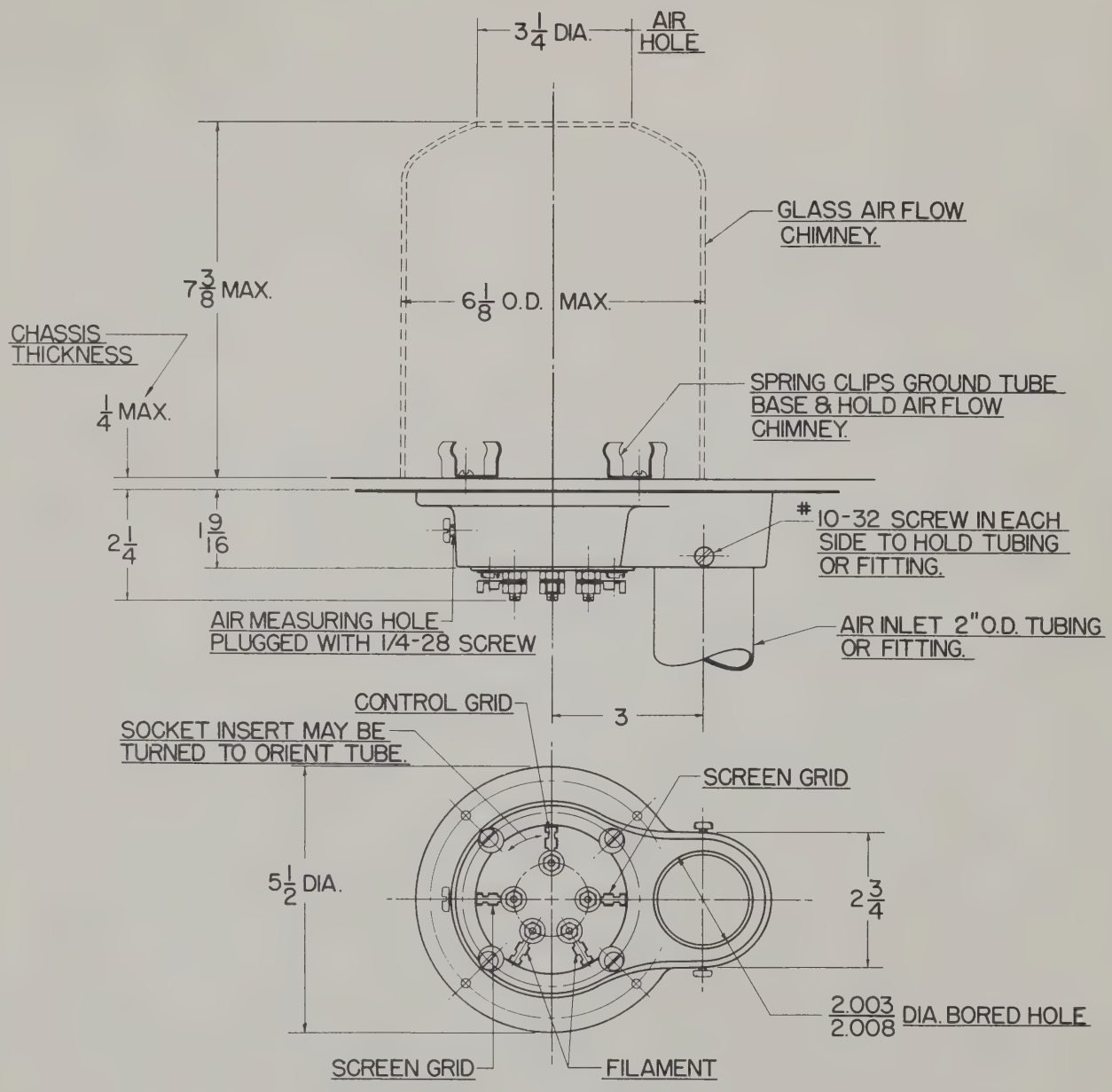
The SK-500 Air-System Socket is designed for under-chassis mounting and requires a 3-3/4-inch diameter hole through the chassis deck. The socket is fastened in place by four No. 10 32 machine screws, running in tapped holes in the cast aluminum body. These four screws also hold four small, double clips, which serve to ground the metal base of the tube and to hold the SK-506 Air Chimney in place.

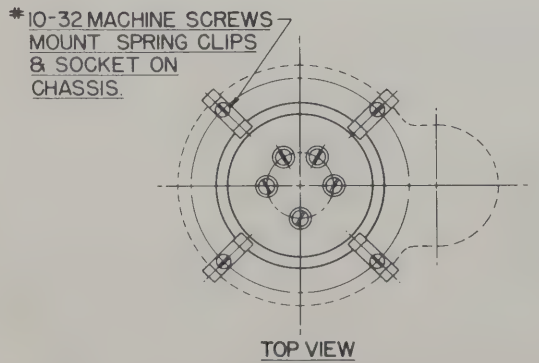
When a tube is inserted in the socket, the five pins on the tube are engaged by five self-aligning pin-jacks in the socket. The connecting leads to the socket must be sufficiently flexible to permit free movement of the pin-jacks, or the self-aligning feature may be impaired.



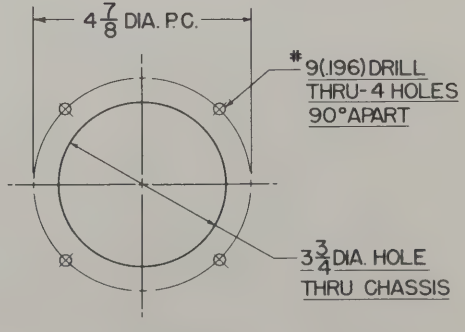
Looking up at a cut-away socket mounted, for demonstration purposes, upon a transparent deck. Arrows indicate the flow of cooling air. The socket mounts flush with the bottom of the deck by means of screws (A) which also position clips (B) on the top of the deck. These clips ground the tube base shell and secure the air-system chimney. Air enters the assembly through air inlet (C). Screw (D) may be used to hold an air duct in the inlet.

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TOP VIEW



CHASSIS DRILLING

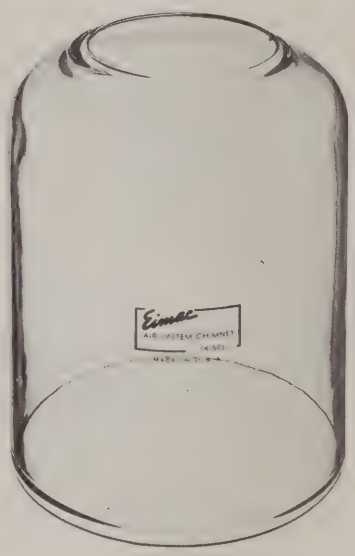
Printed in U.S.A. 10142

Eimac

EITEL-McCULLOUGH, INC.

SK-506
SK-516

AIR-SYSTEM CHIMNEY



The SK-506 and SK-516 Air-System Chimneys are intended for use with those tube and socket combinations listed below. They are used to direct cooling air from the socket across the glass envelope of the tube, past the plate seal and heat radiating connector.

MATERIALS

The SK-506 and SK-516 Air-System Chimneys are made of heat resistant Pyrex glass. The bottom edge is ground flat for a tight air seal against the chassis while the top edge has been fired for smoothness.

INSTALLATION

These chimneys are designed for above-chassis installation over the companion Air-System Socket. Four Spring Clips supplied with the SK-500 and SK-510 sockets ground the metal tube base and act as retaining clips for the chimney.

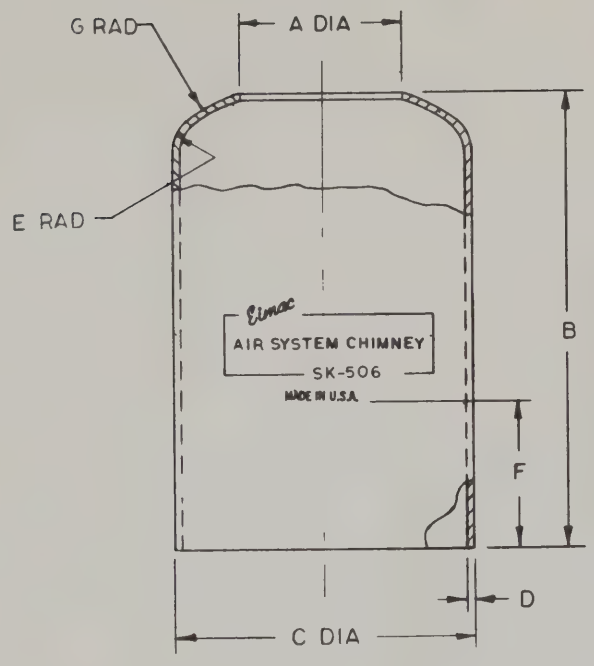
CHIMNEY/TUBE/SOCKET COMBINATIONS

CHIMNEY	TUBE	SOCKET
SK-506	4-1000A 4PR1000A 4PR1000B	SK-500
SK-516	3-1000Z	SK-510

Net Weight - - - - - - - - SK-506 - 10 ounces

SK-516 - 8 ounces

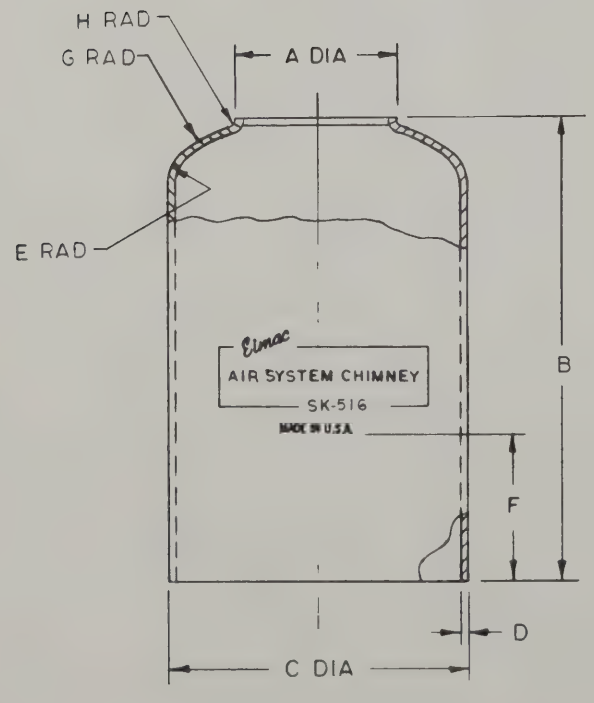
(Effective 5-21-63) © Copyright 1963 by Eitel-McCullough, Inc. Printed in U.S.A.



DIMENSIONAL DATA			
REF	MIN.	MAX	NOM.
A	3.187	3.312	
B	7.125	7.312	
C	5.625	6.875	
D	.080	.174	
E	.625	.875	
F	2.937	3.062	
G	4.500	4.750	

MAT'L: PYREX

SK-506



DIMENSIONAL DATA			
REF	MIN.	MAX	NOM.
A	3.125	3.375	
B	5.750	6.093	
C	5.875	6.125	
D	.080	.174	
E	.625	.875	
F	2.187	2.312	
G	4.500	4.750	
H	.375	.625	

MAT'L: PYREX

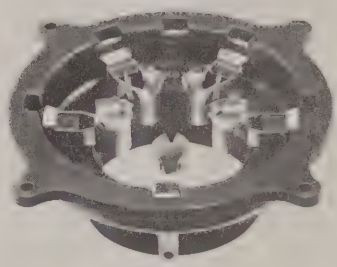
SK-516

EITEL-McCULLOUGH, INC.

SK-510

AIR-SYSTEM SOCKET

The Eimac SK-510 is one of the Air-System Sockets recommended for use with those tube types listed at the bottom of the data sheet or other tube types having the same special five-pin base. Two glass Air-Chimneys are available for use with this socket depending upon the tube type used. The SK-506 Air-Chimney is recommended for use with tube types 4-1000A, 4-1000B and 4PR1000A and the SK-516 Air-Chimney with the 3-1000Z. When this socket is used, connection is made to each of the tube electrodes, except the anode. The SK-510 is humidity and salt-spray resistant.



BASE CONNECTIONS

The SK-510 Air-System Socket consists of five base pin contacting terminals. The terminals are shown on the outline drawing. Four special grounding clips are provided for use with tubes which incorporate metal base shells. It is recommended that these clips be used to prevent the build up of large potentials on the metal shell.

MATERIALS and FINISHES

The shell or body of the socket is mepa-phthalate, per Mil-M-19833. The base contact terminals are fabricated of beryllium-copper, per QQ-C-533, heat-treated after forming, then silver-plated, per QQ-S-365. Eight clips are provided for grounding the metal base shell and holding the Air-Chimney. They are fabricated of beryllium-copper, heat-treated after forming, then cadmium-plated, per QQ-P-416.

INSTALLATION

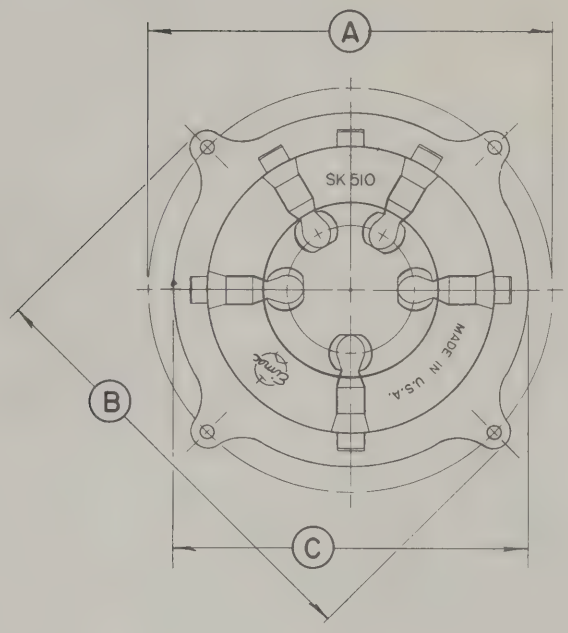
The SK-510 Air-System Socket can be mounted on a chassis deck, partition or pressurized compartment. Chassis mounting is accomplished by cutting a 3-3/4" hole in the chassis deck or partition. The socket is then placed in the hole and fastened in place by four 6-32 machine screws through the four screw holes provided for fastening. This socket has a 2-3/8" O.D. round neck extending 3/4" below the main socket body which provides means for connecting any standard type air-duct to the base. Four additional clips are provided for holding the Air-Chimney.

The SK-510 Air-System Socket Is Recommended For Use With The Following Tube Types:

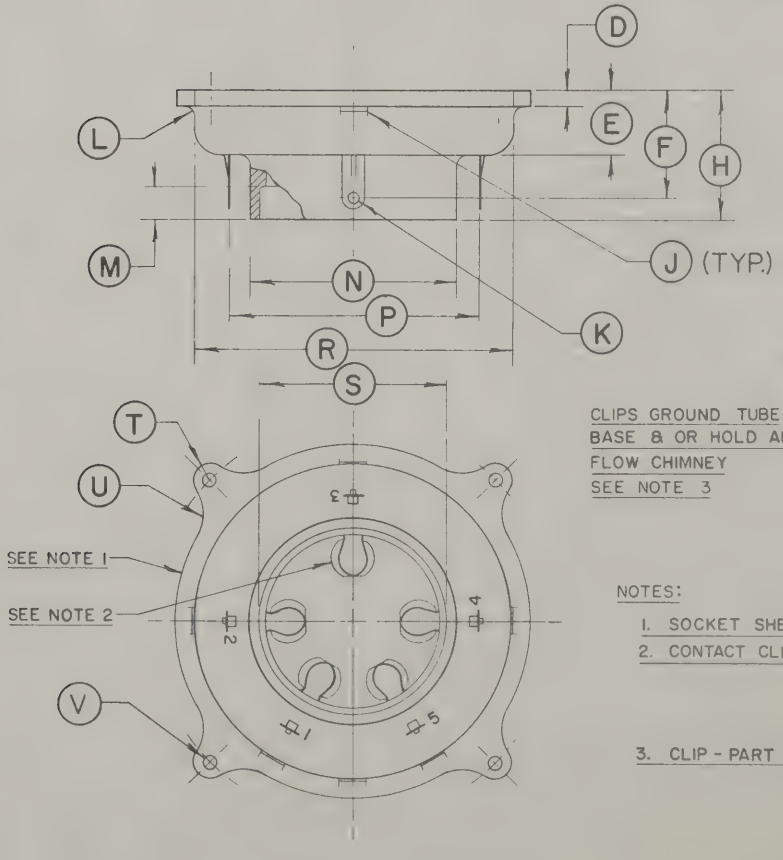
3-1000Z	4-1000B
4-1000A	4PR1000A

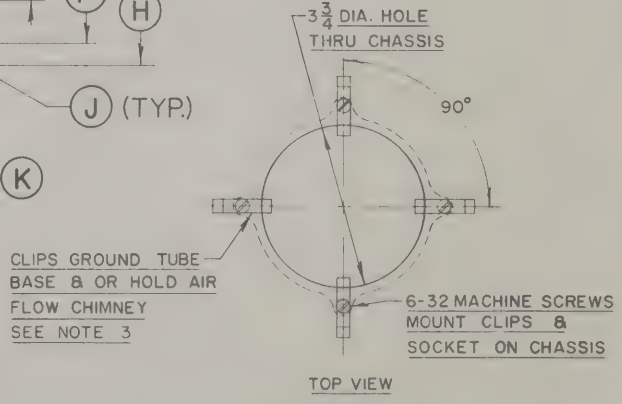
NET WEIGHT . . . . . 6.5 ounces

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DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	$4\frac{19}{32}$ DIA.B.C.	$4\frac{21}{32}$ DIA.B.C.	
B	$4\frac{31}{32}$	$5\frac{1}{32}$	
C	$4\frac{1}{32}$	$4\frac{3}{32}$	
D	$\frac{5}{32}$	$\frac{7}{32}$	
E	$\frac{23}{32}$	$\frac{25}{32}$	
F	$1\frac{7}{32}$	$1\frac{9}{32}$	
H	$1\frac{15}{32}$	$1\frac{17}{32}$	
J	$\frac{1}{32}$ X $\frac{9}{32}$	$\frac{3}{32}$ X $\frac{11}{32}$	
K	$\frac{3}{32}$ DIA.	$\frac{5}{32}$ DIA.	
L	$\frac{3}{32}$R.	$\frac{5}{32}$R.	
M	$\frac{11}{32}$	$\frac{13}{32}$	
N	$2\frac{11}{32}$ DIA.	$2\frac{13}{32}$ DIA.	
P	$2\frac{27}{32}$	$2\frac{15}{32}$	
R	$3\frac{19}{32}$ DIA.	$3\frac{21}{32}$ DIA.	
S	$2\frac{9}{64}$ DIA.	$2\frac{13}{64}$ DIA.	
T	$\frac{5}{32}$ R.	$\frac{7}{32}$ R.	
U	$\frac{15}{32}$ R	$\frac{17}{32}$ R	
V	.139 DIA.	.152 DIA.	





NOTES:

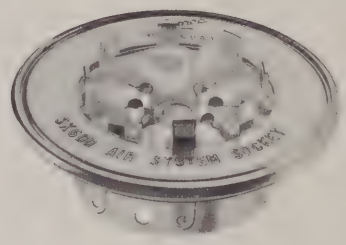
1. SOCKET SHELL – MAT'L: DIALLYL PHTHALATE.
2. CONTACT CLIPS – MAT'L: BERYLLIUM-COPPER PER QQ-C-533. FINISH: SILVER PLATED PER EIMAC SPEC. 016011.
3. CLIP – PART N° 115844N PER DWG. 115842

SK-600

AIR-SYSTEM SOCKET

The Eimac SK-600 is one of the air-system sockets recommended for use with those tubes listed at the bottom of this data sheet or other tube types having the same special nine-pin base. A ceramic SK-606 Air-Chimney is available and is recommended for use with the socket when air-cooled tubes are to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor.



SK-600
Air-System Socket

BASE CONNECTIONS

The SK-600 Air-System Socket consists of eight screen-grid contact fingers, seven pin contacting terminals (no contact is made to pin No. 5), a center control-grid terminal, and an integral screen by-pass capacitor. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance; these contact terminals are insulated from the socket body.

SCREEN-GRID BY-PASS CAPACITOR

Incorporated in the socket structure is a low inductance screen by-pass capacitor, 2700 ± 500 uuf, which provides a short radio-frequency path to ground. The capacitor contains a silvered-mica dielectric and is rated at 400 volts d-c.

When this socket is mounted on a grounded chassis, one side of the screen-grid by-pass capacitor will automatically be grounded.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is silver-plated brass. The screen-grid contact fingers and base pin terminals are fabricated of beryllium-copper, heat-treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water vapors, and is not affected by acids or alkalies. It will not react to normal solvents, except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to +199°C and it is resistant to embrittlement and thermal shock.

NET WEIGHT ..... 3.5 Ounces

INSTALLATION

The SK-600 Air-System Socket can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2¼" diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1⅝" diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

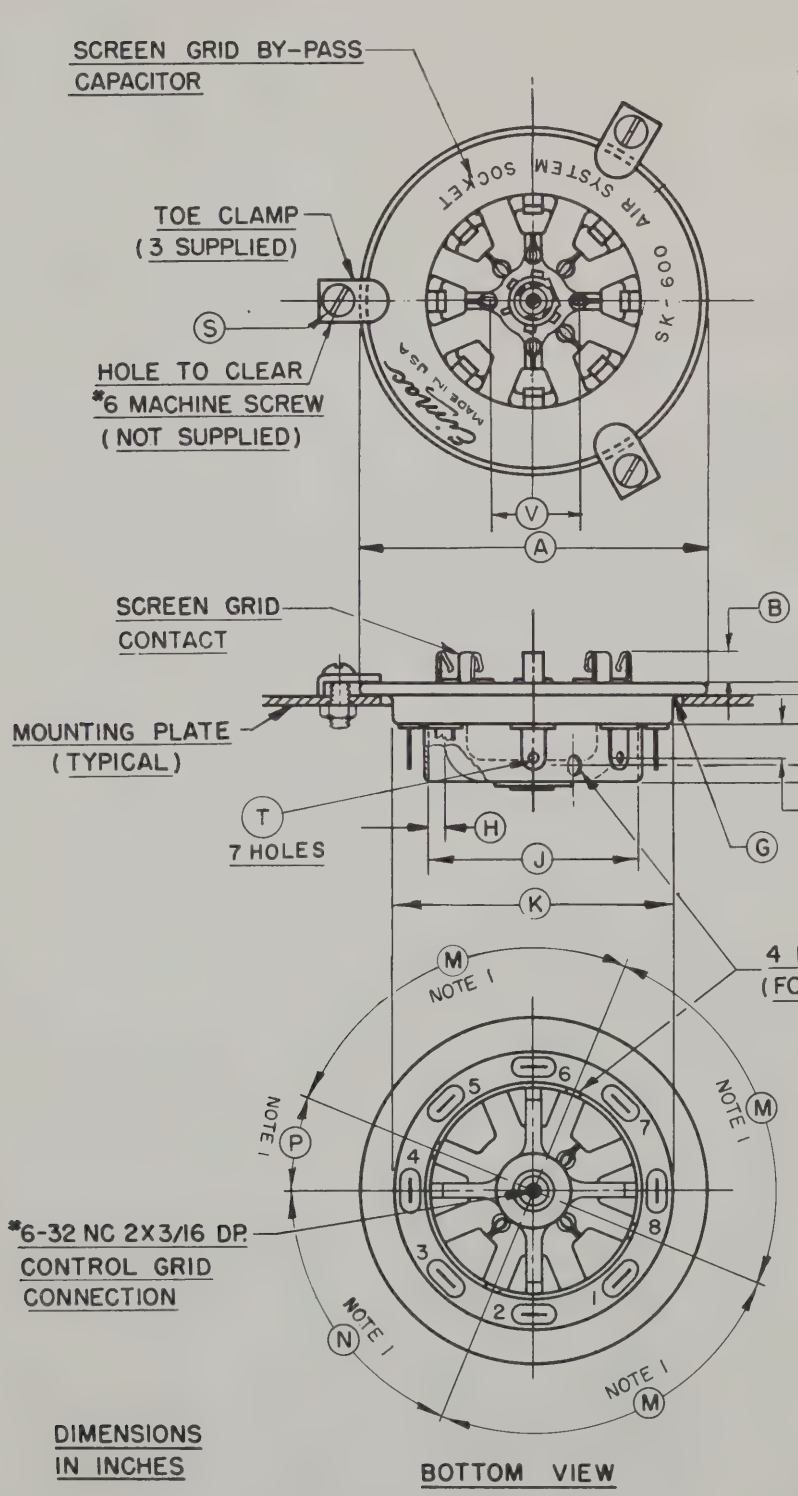
TUBE EXTRACTOR

The SK-604A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-600 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-600 AIR-SYSTEM SOCKET IS RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

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DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	2.688 O.D.	2.750 O.D.	
B	.234	.266	
C	.203	.235	
D	.125	.157	
E	.844	.906	
F			.250
G		.031R	
H			.078
J	1.633 I.D.	1.643 I.D.	
K	2.188 O.D.	2.208 O.D.	
L	.172	.204	
M	89° NOTE *1	91° NOTE *1	
N	66.5° "	68.5° "	
P	21.5° "	23.5° "	
R			.144 DIA.
S	.142 DIA.		
T			.090 DIA.
V			.687 DIA.

CONNECTIONS

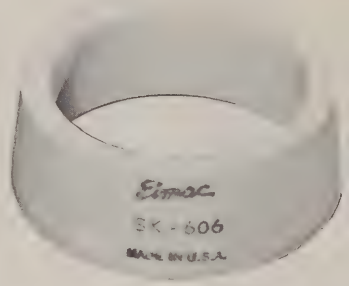
NO. 1 SCREEN GRID
" 2 CATHODE
" 3 HEATER
" 4 CATHODE
" 5 NO CONNECTION
" 6 CATHODE
" 7 HEATER
" 8 CATHODE

NOTES:
1 – TOLERANCES ARE NOT CUMULATIVE

Printed in U.S.A. 986

SK-606
SK-626
SK-636B

AIR-SYSTEM CHIMNEYS

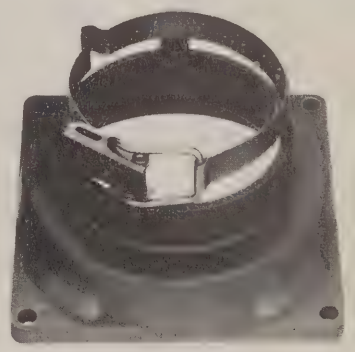


The Eimac SK-606, SK-626 and SK-636B Air System Chimneys are intended for use with those tube and socket combinations listed below.

They are used to direct cooling air into the anode radiator on the tube types listed below.

The SK-636B also helps hold the tube in place by means of a clamping band around the tube's radiator.

MATERIALS



The SK-606 and SK-626 are made of high temperature ceramic. The SK-636B is molded of diallyl meta-phthalate per MIL-M-19833. The clamping band on this socket is made of beryllium copper per QQ-S-365. A neoprene "O" ring is furnished in a recess at the bottom of the socket to more effectively seal the chimney to the socket.

INSTALLATION

The SK-606 and SK-626 ceramic chimneys are installed by slipping them over the tube radiator. They are held in place by their own weight or by some suitable clamping means.

The SK-636B is secured to the chassis over the companion Air-System Socket by means of four #6 screws.

CHIMNEY/TUBE/SOCKET COMBINATIONS

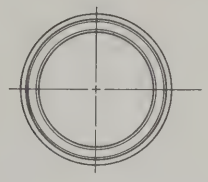
CHIMNEY	SOCKET	TUBE
SK-606	SK-600 SK-600A SK-610 SK-640	4X150A 4X150D 4X150R 4X150S
SK-626 SK-636B	SK-620 SK-620A SK-630 SK-630A	4CX250B 4CX250F 4CX250R 7580
SK-606	SK-700 SK-710 SK-711A	4CX300A 4CX300Y

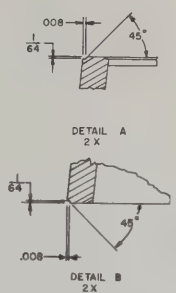
Net Weight - - - - - - - - SK-606 - 1.4 ounces
SK-626 - 1.4 ounces
SK-636B - 1.4 ounces

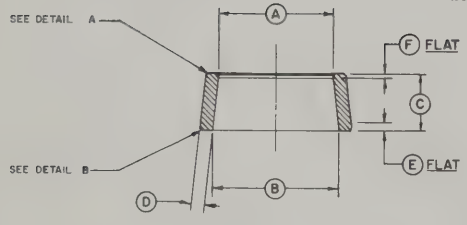
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DIMENSION DATA

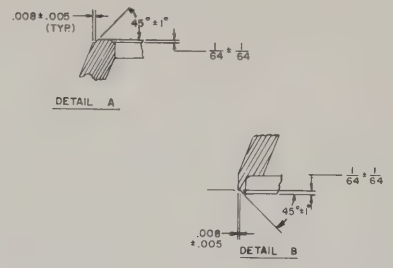
REF.	MIN.	MAX.	NOM.
A	1.645	1.680	
B	1.812	1.850	
C	.812	.875	
D	.156	.218	
E	109	.140	
F	.046	.078	





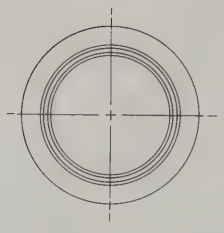


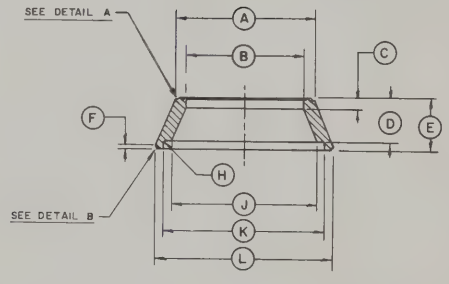
SK-606



DIMENSION DATA

REF.	MIN.	MAX.	NOM.
A	1.980	2.020	
B	1.650	1.720	
C	.105	.145	
D	.573	.613	
E	.698	.738	
F	.042	.082	
H			1/32 R.
J	2.022	2.082	
K	2.300	2.362	
L	2.511	2.551	



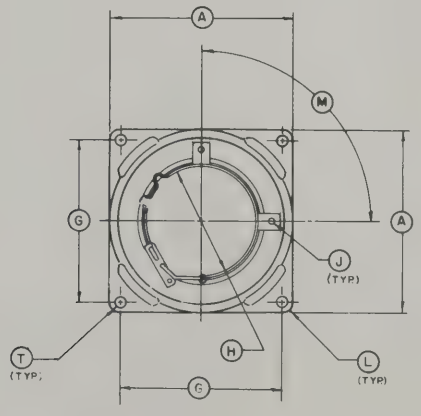


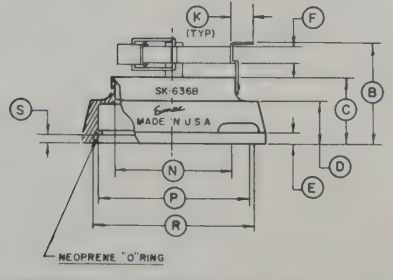
SK-626

DIMENSIONS IN INCHES

DIMENSIONAL DATA

REF.	MIN.	MAX.	NOM.
A	2.609	2.641	
B	1.607	1.677	
C	1.109	1.141	
D	560	600	
E	155	187	
F	.219	.281	
G	2.335	2.365	
H	1.580	1.620	
J	.083	.103	
K	.281	343	
L			1/8 R
M			90°
N	1.651	1.661	
P	2.310	2.320	
R	2.492	2.502	
S	.111	121	
T	.151	161	





NOTES

1. STRAP & BRACKETS OF CLAMP - MATL BE CU PER FED SPEC QQ-C-533 SILVER PLATED AS PER QQ-S-365
2. CHIMNEY - MATL DIALLYL META-PHTHALATE PER MIL-M-19833
3. CLAMP PROVIDES A MIN. 3 LBS. RETENTION ON A 1.625 DIA. TUBE

SK-636B

Eimac®

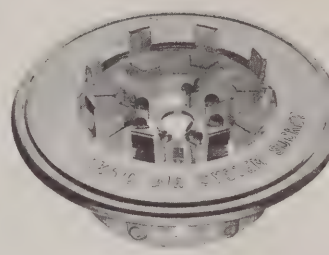
EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

SK-610

AIR-SYSTEM SOCKET

The Eimac SK-610 is one of the air-system sockets recommended for use with those tubes listed at the bottom of this data sheet or other tube types having the same special nine-pin base. A ceramic SK-606 Air-Chimney is available and is recommended for use with the socket when air-cooled tubes are to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor.



SK-610
Air-System Socket

BASE CONNECTIONS

The SK-610 Air-System Socket consists of eight screen-grid contact fingers, seven pin contacting terminals (no contact is made to pin No. 5), a center control-grid terminal, and an integral screen by-pass capacitor. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance. These terminal lugs are connected directly to the metal shell of the socket and will automatically be grounded when the socket is mounted to a metal chassis.

SCREEN-GRID BY-PASS CAPACITOR

Incorporated in the socket structure is a low inductance screen by-pass capacitor, 2700 ± 500 uuf, which provides a short radio-frequency path to ground. The capacitor contains a silvered-mica dielectric and is rated at 400 volts d-c.

When this socket is mounted on a grounded chassis, one side of the screen-grid by-pass capacitor will automatically be grounded.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is silver-plated brass. The screen-grid contact fingers and base pin terminals are fabricated of beryllium-copper, heat-treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water vapors, and is not affected by acids or alkalies. It will not react to normal solvents, except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to +199°C and it is resistant to embrittlement and thermal shock.

NET WEIGHT ..... 3.5 Ounces

INSTALLATION

The SK-610 Air-System Socket can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2¼" diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1⅝" diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

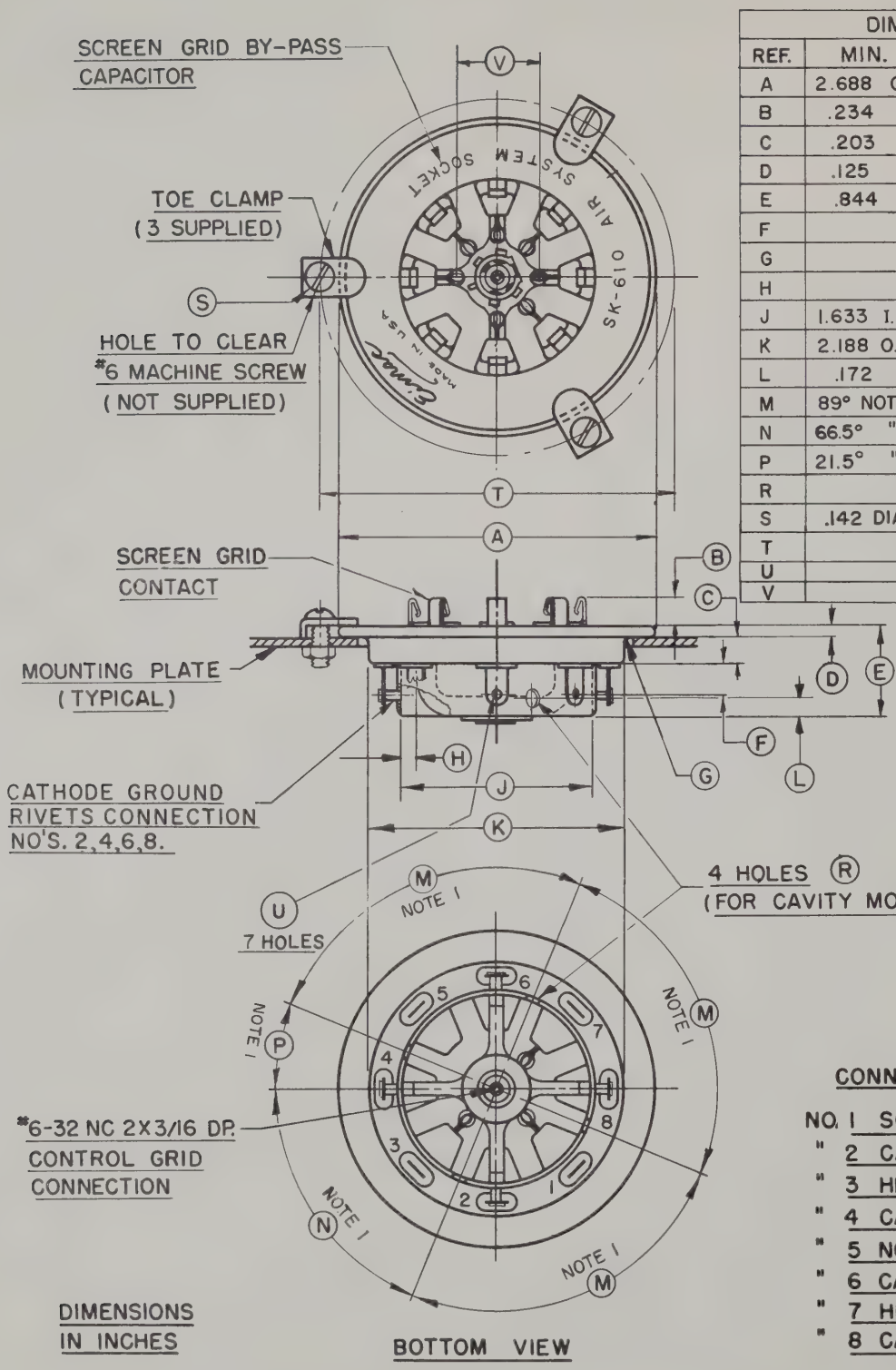
TUBE EXTRACTOR

The SK-604A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-610 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-610 AIR-SYSTEM SOCKET IS RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

4X150A/7034	4X250F/7204	4CX250R
4X150D/7035	4CX250B/7203	4W300B
4X150F/7609	4CX250F	7580
4X250B		

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DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	2.688 O.D.	2.750 O.D.	
B	.234	.266	
C	.203	.235	
D	.125	.157	
E	.844	.906	
F			.250
G		.031R	
H			.078
J	1.633 I.D.	1.643 I.D.	
K	2.188 O.D.	2.208 O.D.	
L	.172	.204	
M	89° NOTE #1	91° NOTE #1	
N	66.5° "	68.5° "	
P	21.5° "	23.5° "	
R			.144 DIA.
S	.142 DIA.		
T			3.000 DIA.
U			.090 DIA.
V			.687 DIA.

DIMENSIONS IN INCHES

BOTTOM VIEW

CONNECTIONS

NO. 1 SCREEN GRID
" 2 CATHODE
" 3 HEATER
" 4 CATHODE
" 5 NO CONNECTION
" 6 CATHODE
" 7 HEATER
" 8 CATHODE

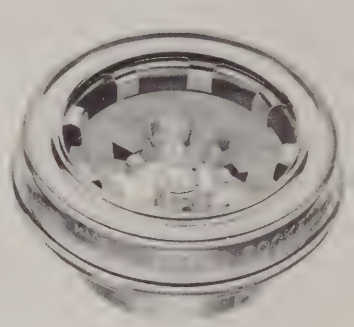
NOTES:
1 – TOLERANCES ARE NOT CUMULATIVE

Printed in U.S.A. 987

EITEL-McCULLOUGH, INC.
SAN CARLOS CALIFORNIA

SK-620
SK-620A

AIR-SYSTEM SOCKET



The Eimac SK-620 is one of the Air-System Sockets recommended for use with those tubes listed at the bottom of this data sheet or other tube types having the same special nine-pin base. A ceramic SK-626 Air Chimney or a fiberglass-reinforced silicone resin SK-636 Air Chimney are also available and are recommended for use with the socket when air-cooled tubes are to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor. The SK-620 Air-System Socket is humidity and salt-spray resistant. The SK-620A is an improved SK-620 which includes a slightly modified screen by-pass capacitor sealed with an improved encapsulating material to insure reliable performance under high humidity or moisture conditions.

BASE CONNECTIONS

The SK-620 Air-System Socket consists of eight screen-grid contact fingers, seven pin contacting terminals (no contact is made to pin No. 5), a center control-grid terminal, and an integral screen by-pass capacitor. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance; these terminal lugs are insulated from the socket body.

SCREEN-GRID BY-PASS CAPACITOR

Incorporated in the socket structure is a low-inductance screen by-pass capacitor, 1100 uuf ±20%, which provides a short radio-frequency path to ground. The silvered-mica dielectric, encapsulated in epoxy resin, is humidity and salt-spray resistant. The sockets are hi-voltage tested at 2000 volts dc and are rated for use at 1000 volts dc.

When this socket is mounted on a grounded chassis, one side of the screen-grid by-pass capacitor will automatically be grounded.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is silver-plated brass. The screen-grid contact fingers and base pin terminals are fabricated of beryllium-copper, heat-treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water vapors, and is not affected by acids or alkalies. It will not react to normal solvents, except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of -196°C to +199°C and it is resistant to embrittlement and thermal shock.

NET WEIGHT . . . . . 4 Ounces

INSTALLATION

The SK-620 and SK-620A Air-System Sockets can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2-1/4" diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1-5/8" diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

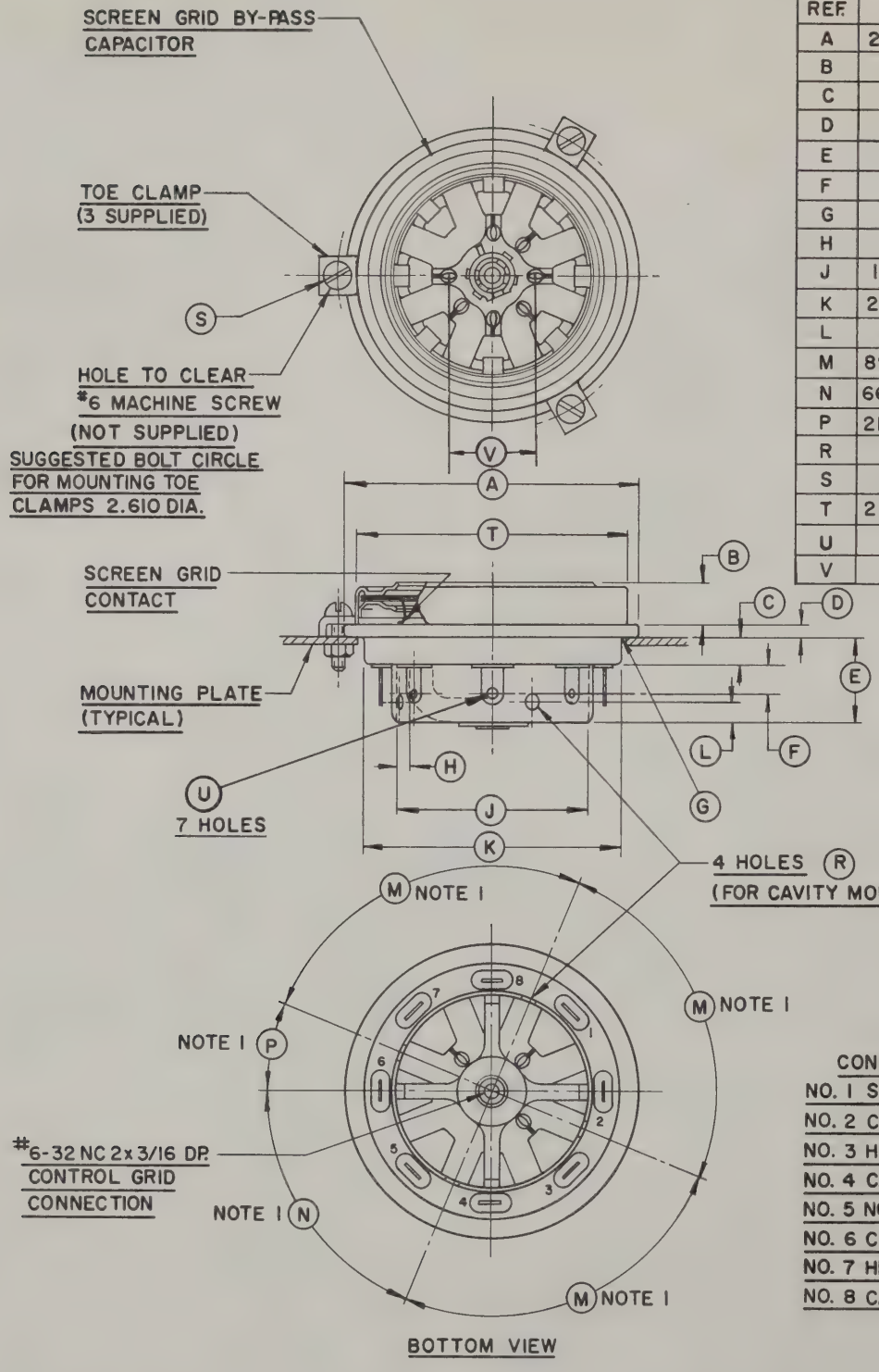
TUBE EXTRACTOR

The SK-604A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-620 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-620 AND SK-620A AIR-SYSTEM SOCKETS ARE RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

(Effective 1-15-63) © 1961, 1962, 1963 by Eitel-McCullough, Inc.



DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	2.438 O.D.	2.498 O.D.	
B	.348	.388	
C	.203	.235	
D	.105	.145	
E	.700	.740	
F			.250
G		.031 R.	
H			.078
J	1.633 I.D.	1.643 I.D.	
K	2.188 O.D.	2.208 O.D.	
L	.172	.204	
M	89° NOTE 1	91° NOTE 1	
N	66.5° "	68.5° "	
P	21.5° "	23.5° "	
R			.144 DIA.
S	.142 DIA.		
T	2.285 O.D.	2.305 O.D.	
U			.090 DIA
V			.687 DIA.

CONNECTIONS
NO. 1 SCREEN GRID
NO. 2 CATHODE
NO. 3 HEATER
NO. 4 CATHODE
NO. 5 NO CONNECTION
NO. 6 CATHODE
NO. 7 HEATER
NO. 8 CATHODE

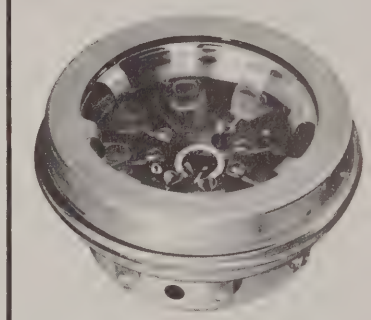
DIMENSIONS IN INCHES.

NOTE:
1. TOLERANCES ARE NOT CUMULATIVE.
2. WORD "EIMAC" IN SOCKET IDENTIFICATION LABEL IS LOCATED (APPROX) NEXT TO PIN NO. 5.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

SK-630
SK-630A

AIR-SYSTEM SOCKET



The Eimac SK-630 is one of the Air-System Sockets recommended for use with those tubes listed at the bottom of this data sheet or other tube types having the same special nine-pin base. A ceramic SK-626 Air Chimney or a fiberglass-reinforced silicone resin SK-636 Air Chimney are also available and are recommended for use with the socket when air-cooled tubes are to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor. The SK-630 Air-System Socket is humidity and salt-spray resistant. The SK-630A is an improved SK-630 which includes a slightly modified screen by-pass capacitor sealed with an improved encapsulating material to insure reliable performance under high humidity or moisture conditions.

BASE CONNECTIONS

The SK-630 Air-System Socket consists of eight screen-grid contact fingers, seven pin contacting terminals (no contact is made to pin No. 5), a center control-grid terminal, and an integral screen by-pass capacitor. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance. These terminal lugs are connected directly to the metal shell of the socket and will automatically be grounded when the socket is mounted to a metal chassis.

SCREEN-GRID BY-PASS CAPACITOR

Incorporated in the socket structure is a low-inductance screen by-pass capacitor, 1100 uuf ±20%, which provides a short radio-frequency path to ground. The silvered-mica dielectric, encapsulated in epoxy resin, is humidity and salt-spray resistant. The sockets are hi-voltage breakdown tested at 2000 volts dc and are rated for use at 1000 volts dc.

When this socket is mounted on a grounded chassis, one side of the screen-grid by-pass capacitor will automatically be grounded.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is silver-plated brass. The screen-grid contact fingers and base pin terminals are fabricated of beryllium-copper, heat-treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water vapors, and is not affected by acids or alkalies. It will not react to normal solvents, except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of -196°C to +199°C and it is resistant to embrittlement and thermal shock.

NET WEIGHT . . . . . 4 Ounces

INSTALLATION

The SK-630 and SK-630A Air-System Socket can be mounted on chassis decks or partitions or in coaxial tuning devices with no modification to the socket. Chassis mounting is accomplished by cutting a 2-1/4" diameter hole in the chassis deck or partition. The socket is then placed in the hole and held securely by the three toe clamps provided.

If the socket is to be used in a coaxial line, it may be mounted directly on the end of the input line outer conductor. The socket skirt fits snugly on a 1-5/8" diameter cylinder and four screw holes are provided for fastening as shown in the outline drawing.

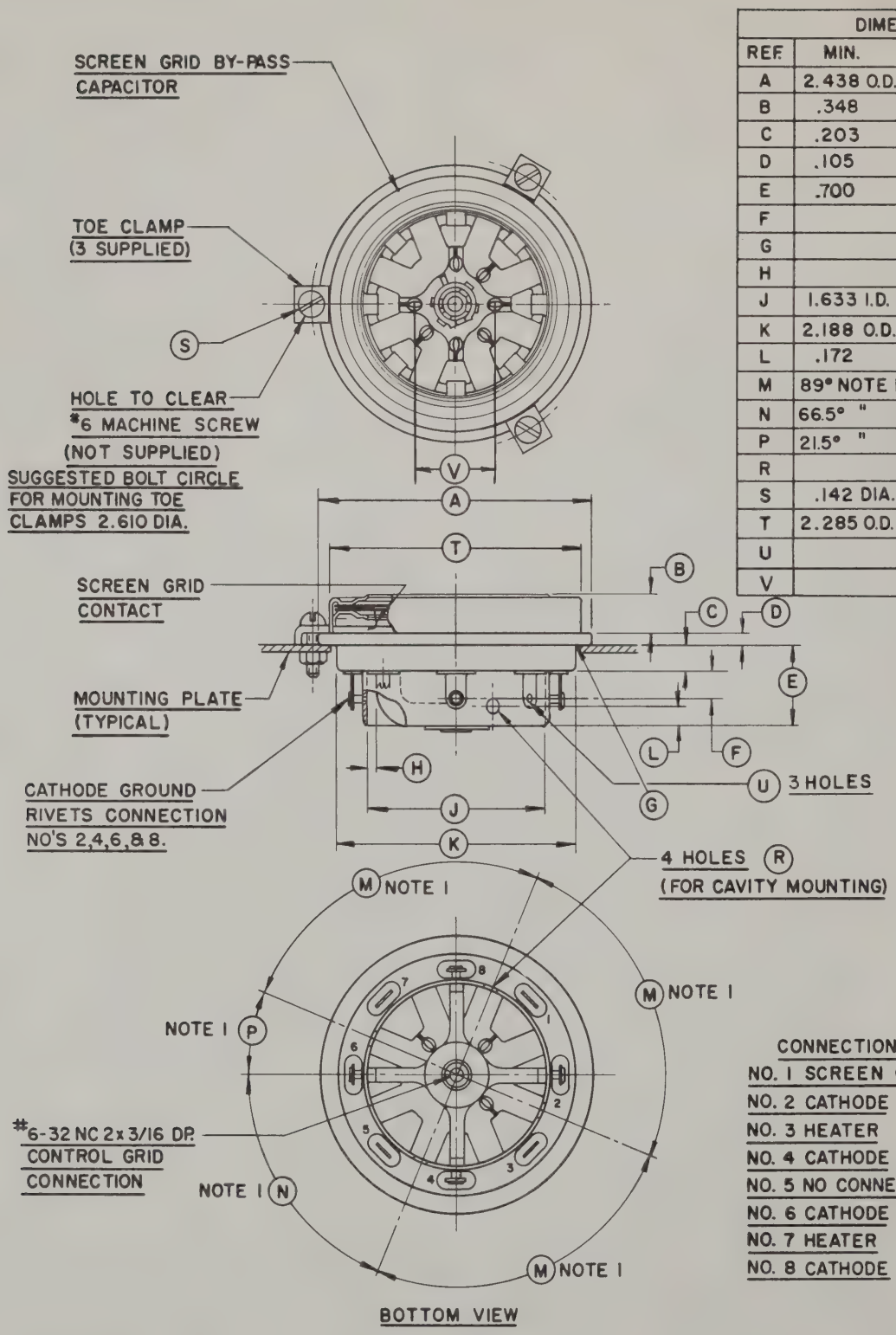
TUBE EXTRACTOR

The SK-604A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-630 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-630 AND SK-630A AIR-SYSTEM SOCKETS ARE RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

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BOTTOM VIEW

DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	2.438 O.D.	2.498 O.D.	
B	.348	.388	
C	.203	.235	
D	.105	.145	
E	.700	.740	
F			.250
G		.031 R.	
H			.078
J	1.633 I.D.	1.643 I.D.	
K	2.188 O.D.	2.208 O.D.	
L	.172	.204	
M	89° NOTE 1	91° NOTE 1	
N	66.5° "	68.5° "	
P	21.5° "	23.5° "	
R			.144 DIA.
S	.142 DIA.		
T	2.285 O.D.	2.305 O.D.	
U			.090 DIA
V			.687 DIA.

CONNECTIONS
NO. 1 SCREEN GRID
NO. 2 CATHODE
NO. 3 HEATER
NO. 4 CATHODE
NO. 5 NO CONNECTION
NO. 6 CATHODE
NO. 7 HEATER
NO. 8 CATHODE

DIMENSIONS IN INCHES.

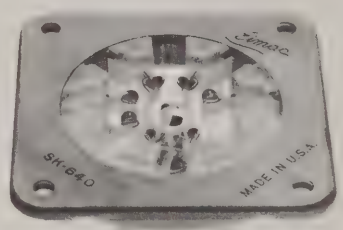
NOTE:
1. TOLERANCES ARE NOT CUMULATIVE.
2. WORD "EIMAC" IN SOCKET IDENTIFICATION LABEL IS LOCATED (APPROX) NEXT TO PIN NO. 5.

EITEL-McCULLOUGH, INC.

SK-640

AIR-SYSTEM SOCKET

The Eimac SK-640 is one of the air system sockets recommended for use with those tubes listed at bottom of the page, or other tube types having the same special nine-pin base, when an integral screen by-pass capacitor is either not required or desired. When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-640 Air-System Socket is humidity and salt-spray resistant.



SK-640
Air-System Socket

BASE CONNECTIONS

The SK-640 Air-System Socket consists of seven base pin contacting terminals (no contact is made to Pin #5) and a center control-grid terminal. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which are connected in parallel to minimize the effects of lead inductance. These terminal lugs are insulated from the socket body. Connection to the screen-grid is made via Pin #1 while control-grid contact is accomplished by the use of a 6/32″ screw at the center terminal.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is nickel-plated brass and the base pin contact terminals are fabricated from beryllium-copper, heat treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass as are the toe clamps which are supplied for mounting purposes.

The socket insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water-vapors and is not affected by acids or alkalies. It will not react to normal solvents except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to + 199° C and it is resistant to embrittlement and thermal shock.

NET WEIGHT ..... 2.0 ounces

INSTALLATION

The SK-640 Air-System Socket can be mounted on a chassis decks or partitions by the four 0.150 inch diameter holes provided in the socket body. These holes are 90° apart and are drilled on a 2-9/16″ diameter pitch circle. A 2-1/4″ hole is required to accept the socket body.

TUBE EXTRACTOR

The SK-604A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-640 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

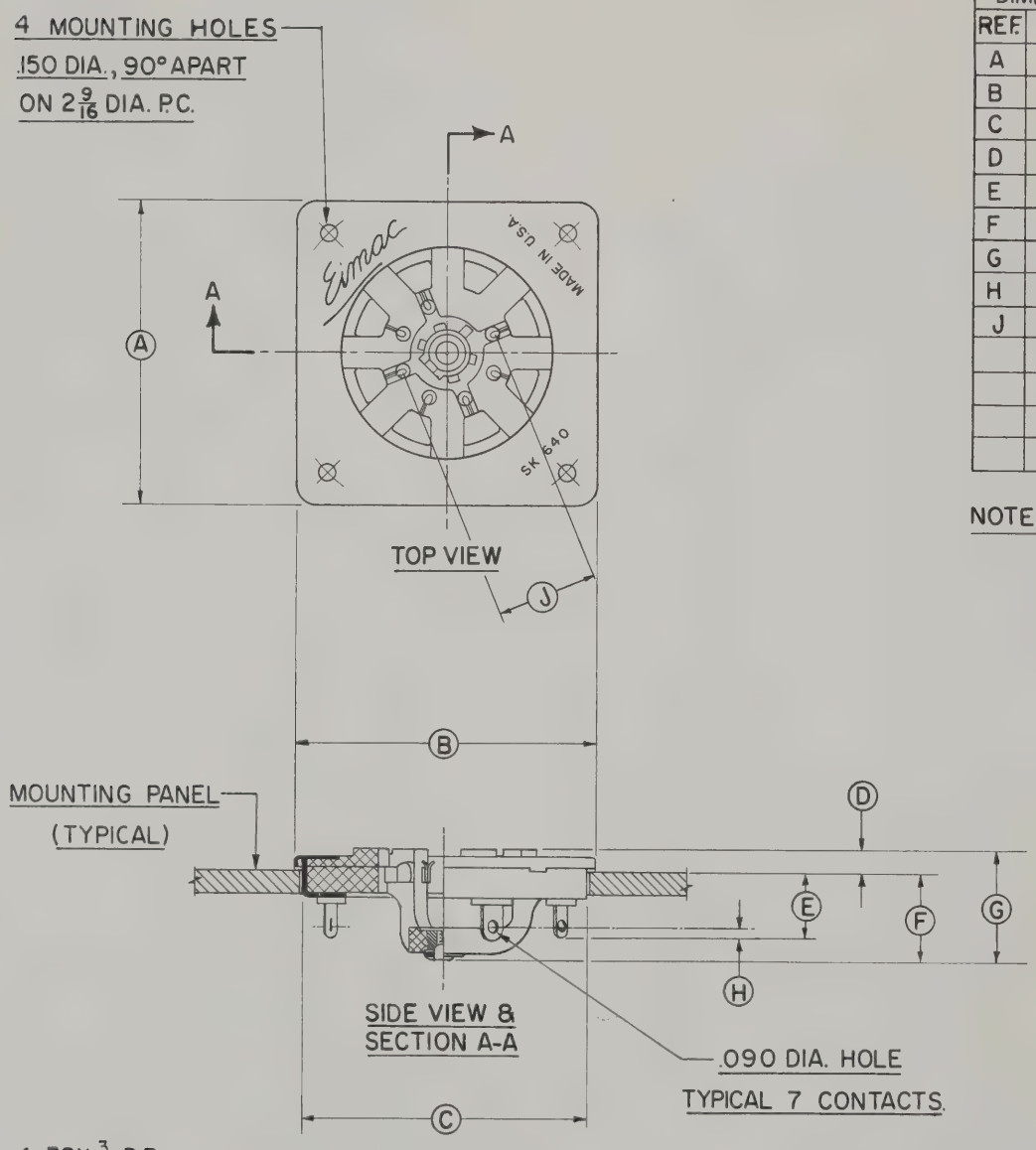
THE SK-640 AIR-SYSTEM SOCKET IS RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

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DIMENSIONS IN INCHES			
REF.	MIN.	MAX.	NOM.
A			2.314
B			2.314
C			2.194 D.
D			.167
E			.548
F			.712
G			.879
H			.089
J			.687 DIA.

NOTE: TOLERANCES ARE NOT CUMULATIVE



CONNECTIONS
1. SCREEN GRID
2. CATHODE
3. HEATER
4. CATHODE
5. NO CONNECTION
6. CATHODE
7. HEATER
8. CATHODE

Printed in U.S.A. 990

Eimac®

EITEL-McCULLOUGH, INC.

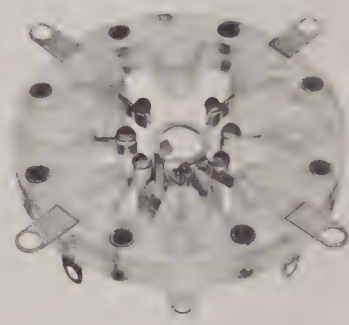
SK-650
SK-655

AIR-SYSTEM SOCKET

The Eimac SK-650 is one of the Air-System Sockets recommended for use with those tubes listed at the bottom of the page, or other tube types having the same special nine-pin base, when a compact, low-cost, special purpose socket is required. When this socket is used, connection is made to each of the tube electrodes except the anode.

The SK-655 Screen By-Pass Capacitor is a separate encapsulated capacitor designed for use with the SK-650 Air-System Socket. When this combination is used, the screen by-pass capacitor can be replaced without troublesome or costly repairs.

Both the SK-650 and the SK-655 are humidity and salt-spray resistant.



SK-650
Air-System Socket



SK-655 Screen
By-Pass Capacitor

BASE CONNECTIONS

The SK-650 Air-System Socket consists of seven base pin contacting terminals (no contact is made to Pin #5) and a center control-grid terminal. The cathode of the tube is connected to its external circuits by the four even-numbered base pins which, in turn, are connected to the four socket mounting tabs. Connections are made in this manner to minimize the effects of lead inductance. When the SK-650 Air-System Socket is used alone, connection is made to the screen-grid via Pin #1. Control grid contact is accomplished by means of a 6/32″ screw at the center terminal.

THE SK-655 SCREEN-GRID BY-PASS CAPACITOR

The SK-655 Screen-Grid By-Pass Capacitor is an independent encapsulated capacitor which is mounted to the SK-650 Air-System Socket by the same four socket mounting screws. This is a low-inductance capacitor, 1100 uuf $\pm$ 20%, which provides a short radio-frequency path to ground. The capacitor is hi-voltage breakdown tested at 2000 volts d-c and rated at 1000 volts d-c. When the SK-655 is mounted on a grounded chassis, one side of the screen by-pass capacitor is automatically grounded.

MATERIALS AND FINISHES

In the SK-650 Air-System Socket, the base pin terminals and the four mounting lugs are fabricated of beryllium-copper, heat treated after forming, then silver-plated. The center control-grid terminal is silver-plated brass.

The insulating material, polytrifluorochloroethylene, is chemically inert, non-flammable, will not absorb water or water-vapors and is not affected by acids or alkalies. It will not react to normal solvents except in the case of halogenated compounds which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −196°C to +199°C and it is resistant to embrittlement and thermal shock.

The SK-655 Screen By-Pass Capacitor has a body, or shell, constructed of silver-plated brass while the eight screen-grid contacting fingers are heat treated, silver-plated beryllium-copper. The capacitor dielectric is silvered-mica and is encapsulated in epoxy resin.

Net Weight of the SK-650 Air-System Socket ..... 1.2 ounces

Net Weight of the SK-655 Screen-Grid By-Pass Capacitor ..... 1.5 ounces

INSTALLATION

Both the SK-650 Air-System Socket and the SK-655 Screen-Grid By-Pass Capacitor can be mounted to a chassis deck or partition by the four 0.130″ diameter holes provided in each of the assemblies. Both units have holes which are 90° apart and are drilled on 2-17/32″ diameter pitch circle.

The SK-650 Air-System Socket requires a 2-1/8″ diameter hole to accept the socket body.

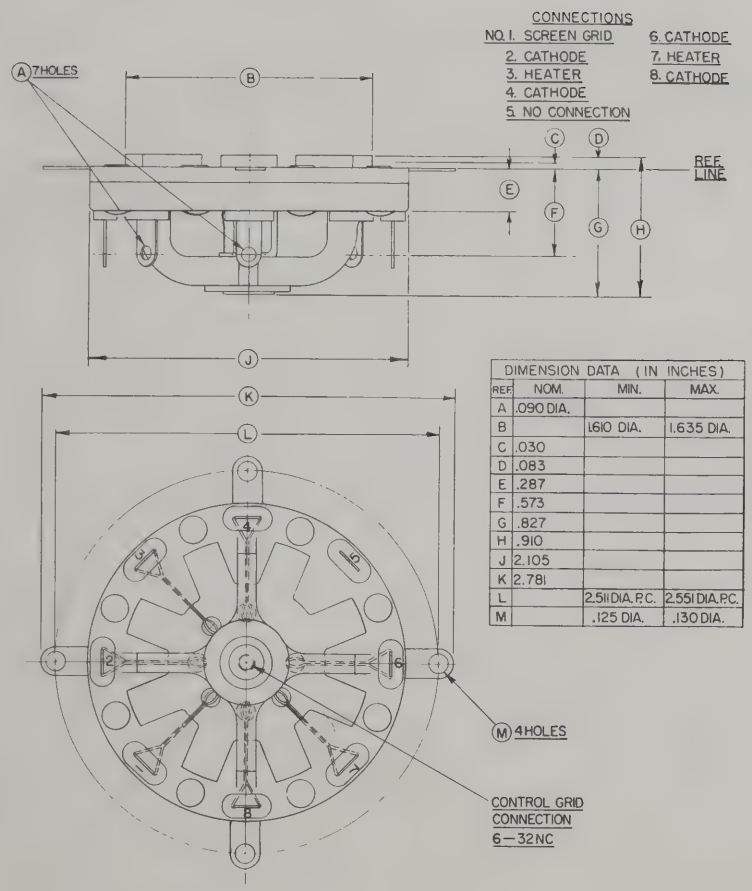
TUBE EXTRACTOR

The SK-604A is a spring-steel device useful for inserting and extracting tubes of the type used in the SK-650 Air-System Socket. It is recommended for use where the construction of the equipment makes it difficult or impossible to grasp the tube by hand or when it is necessary to handle the tubes while they are still hot from recent use.

THE SK-650 AIR-SYSTEM SOCKET IS RECOMMENDED FOR USE WITH THE FOLLOWING TUBES:

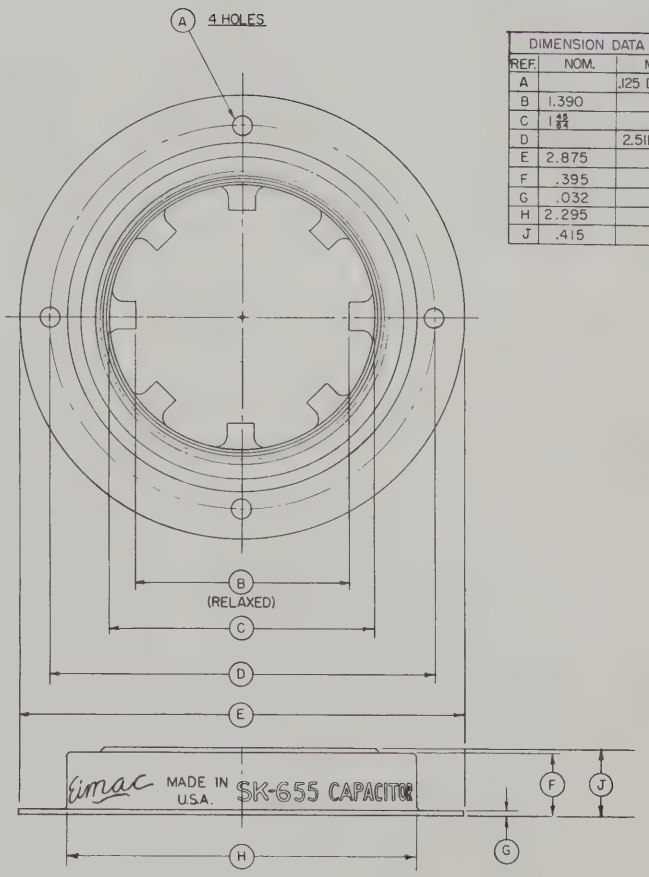
7034/4X150A	7204/4CX250F	8321/4CX350A
7035/4X150D	7580W/4CX250R	8322/4CX350F
7203/4CX250B	8249/4W300B	7580

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DIMENSION DATA (IN INCHES)			
REF.	NOM.	MIN.	MAX.
A	.090 DIA.		
B		1.610 DIA.	1.635 DIA.
C	.030		
D	.083		
E	.287		
F	.573		
G	.827		
H	.910		
J	2.105		
K	2.781		
L		2.511 DIA. P.C.	2.551 DIA. P.C.
M		.125 DIA.	.130 DIA.

SK-650 OUTLINE DRAWING



DIMENSION DATA (IN INCHES)			
REF.	NOM.	MIN.	MAX.
A		.125 DIA.	.130 DIA.
B	1.390		
C	1 43/64		
D		2.511	2.551
E	2.875		
F	.395		
G	.032		
H	2.295		
J	.415		

SK-655 OUTLINE DRAWING

Printed in U.S.A. 991

EITEL-McCULLOUGH, INC.
SAN CARLOS • CALIFORNIA

SK-700 AND SK-710 AIR-SYSTEM SOCKETS

The Eimac SK-700 and SK-710 Air-System Sockets are designed to socket the Eimac 4CX300A. Connections are made to each of the tube electrodes except the anode. An integral screen-grid by-pass capacitor is built into the socket.

SK-700

The cathode contacts are insulated from ground.

SK-710

All six of the cathode contacts are connected directly to the metal body.

HEATER CONNECTIONS

In both socket types, one heater contact is connected directly to the metal body.

SCREEN-GRID BY-PASS CAPACITOR

The capacitor is built into the socket and provides a low-impedance path to ground for screen-grid r-f currents. It is tested at 1000 volts d-c and rated at 400 volts d-c. Capacitance is 1100 $\mu\mu$f $\pm$ 20%.

MATERIALS AND FINISHES

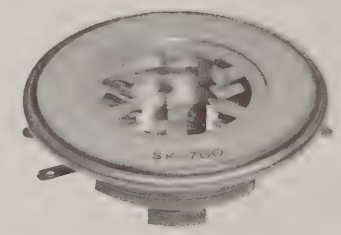
The metal shell, or body, of the socket is made of silver-plated brass. The non-ferrous alloy contacts are heat treated after forming and then silver plated. Three silver-plated brass toe clamps are supplied for mounting purposes.

The socket insulating material is chemically inert, non-flammable, and will not absorb water or water vapor. It is not affected by strong or weak acids or alkalies. It will not react to normal solvents except in the case of halogenated compounds, which will induce minor dimensional changes. Its physical characteristics are stable over a temperature range of −150°C to +275°C and it is resistant to embrittlement and thermal shock.

A silvered-mica dielectric is used in the screen-grid by-pass capacitor.

AIR CHIMNEY

The SK-606 is intended to be used with the 4CX300A mounted vertically with the anode up. If horizontal mounting or vertical mounting with the anode down is required, means should be provided to retain the chimney. The air chimney is made of high-temperature ceramic and serves to direct the flow of air emerging from the socket into the anode cooling fins. It is recommended that the SK-606 chimney, or its equivalent, be used with each SK-700 or SK-710 socket.



SK-700

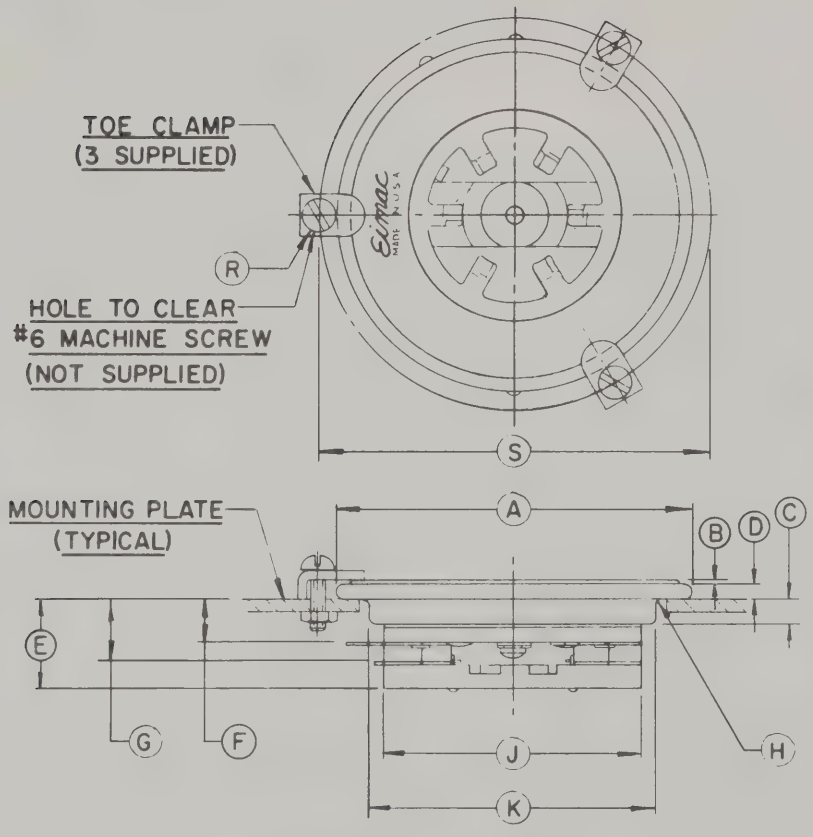


SK-700 WITH SK-606

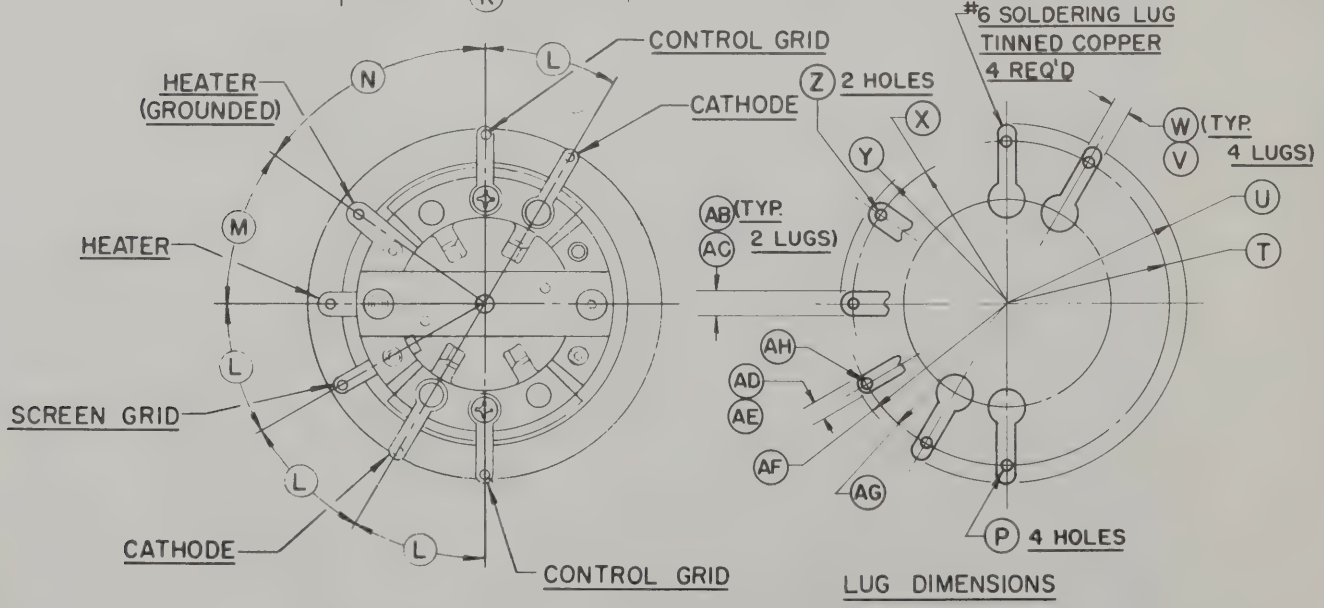


SOCKET, TUBE, AND CHIMNEY

(Effective 1-20-58) Copyright 1958 By Eitel-McCullough, Inc.



DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	2.688 O.D.	2.750 O.D.	
B	.014	.046	
C	.175	.207	
D	.107	.147	
E	.650	.690	
F	.312	.352	
G	.453	.493	
H		.031 R.	
J	1.965 O.D.	1.975 O.D.	
K	2.184 O.D.	2.204 O.D.	
L	29°	31°	
M	34°	36°	
N	54°	56°	
P	.080 DIA.	.085 DIA.	
R	.142 DIA.		
S			3.000 DIA
T	1 15/64 R.	1 17/64 R.	
U	1 23/64 R.	1 25/64 R.	
V	7/64	9/64	
W	.020 THK.	.030 THK.	
X	1 5/64 R.	1 7/64 R.	
Y	1 17/64 R.	1 19/64 R.	
Z	3/64 DIA.	5/64 DIA.	
AB	11/64	13/64	
AC	.005 THK.	.015 THK.	
AD	7/64	9/64	
AE	.015 THK.	.025 THK.	
AF	1 19/64 R.	1 21/64 R.	
AG	1 15/64 R.	1 17/64 R.	
AH	.065 DIA.	.075 DIA.	

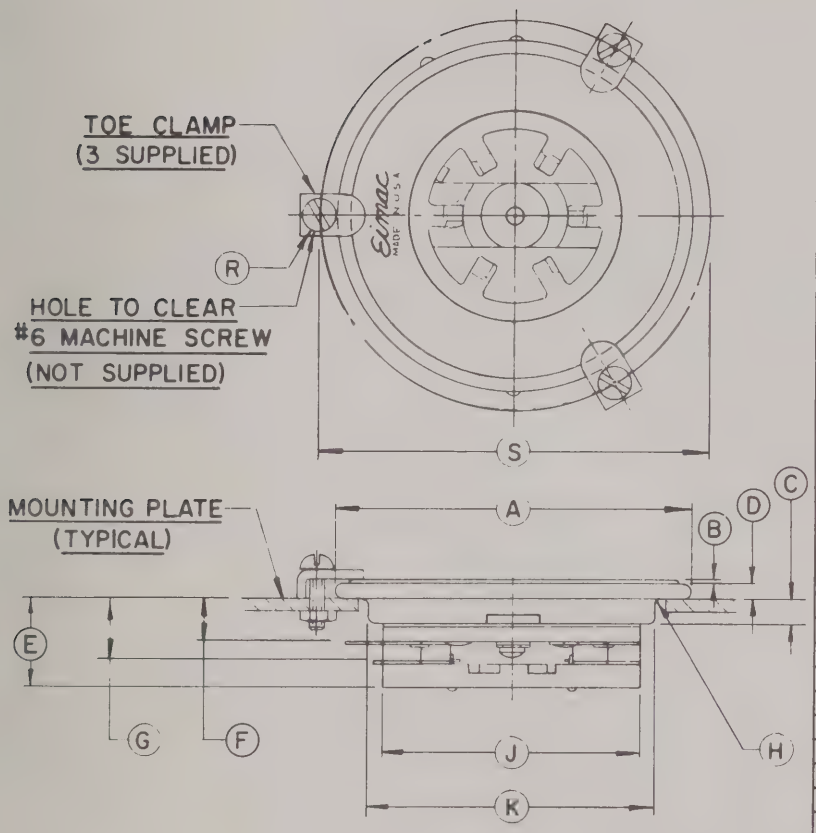


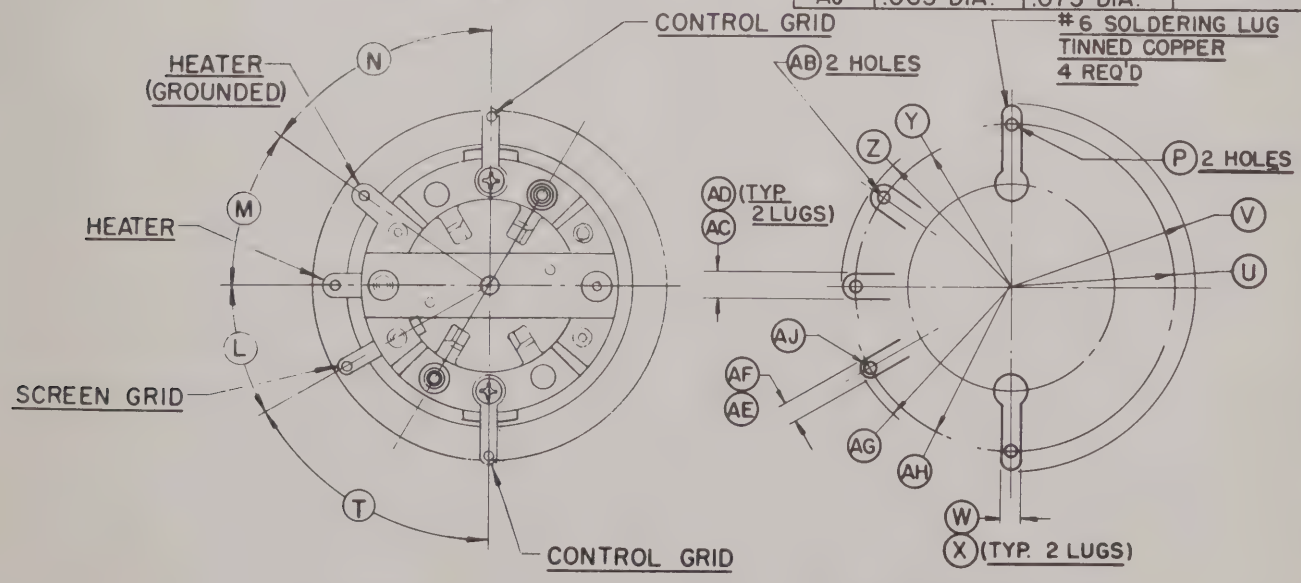
LUG DIMENSIONS
(DETAILS OMITTED FOR CLARITY.)

NOTES:
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES.

OUTLINE AIR-SYSTEM SOCKET SK-700 (UNGROUNDED CATHODE)

DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	2.688 O.D.	2.750 O.D.	
B	.014	.046	
C	.175	.207	
D	.107	.147	
E	.650	.690	
F	.312	.352	
G	.453	.493	
H		.031 R.	
J	1.965 O.D.	1.975 O.D.	
K	2.184 O.D.	2.204 O.D.	
L	29°	31°	
M	34°	36°	
N	54°	56°	
P	.080 DIA.	.085 DIA.	
R	.142 DIA.		
S			3.000 DIA
T	59°	61°	
U	1 15/64 R.	1 17/64 R.	
V	1 23/64 R.	1 25/64 R.	
W	7/64	9/64	
X	.020 THK.	.030 THK.	
Y	1 5/64 R.	1 7/64 R.	
Z	1 17/64 R.	1 19/64 R.	
AB	3/64 DIA.	5/64 DIA.	
AC	11/64	13/64	
AD	.005 THK.	.015 THK.	
AE	7/64	9/64	
AF	.015 THK.	.025 THK.	
AG	1 19/64 R.	1 21/64 R.	
AH	1 15/64 R.	1 17/64 R.	
AJ	.065 DIA.	.075 DIA.	





NOTES:
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES.

LUG DIMENSIONS
(DETAILS OMITTED
FOR CLARITY)

OUTLINE AIR-SYSTEM SOCKET SK-710 (GROUNDED CATHODE)

SK-606 CHIMNEY

Printed in U.S.A. 38560

Eimac

EITEL-McCULLOUGH, INC.

SK-711A

AIR-SYSTEM SOCKET



The Eimac SK-711A Air-System Socket is designed to socket the Eimac 4CX300A and other members of this family listed below. Connections are made to each of the tube electrodes except the anode. An integral screen-grid by-pass capacitor is built into the socket.

The SK-711A differs from the SK-710 in that the capacitor decks have been especially flanged and the exposed dielectric is sealed. These changes permit a screen voltage rating of 350 volts at 60,000 feet.

CONTACTS

All six of the cathode contacts are connected directly to the metal body.

HEATER CONNECTIONS

In both socket types, one heater contact is connected directly to the metal body.

SCREEN-GRID BY-PASS CAPACITOR

The capacitor is built into the socket and provides a low-impedance path to ground for screen-grid r-f currents. It is tested at 1000 volts dc and rated at 400 volts dc. Capacitance is 1100 $\mu\mu$f $\pm$20%. In addition, the screen by-pass capacitor is modified and differs from the SK-710 in that the capacitor is sealed with epoxy. The sealing provides a longer voltage breakdown path and prevents contamination. It is useable in high humidity environments.

MATERIALS and FINISHES

The metal shell, or body, of the socket is made of silver-plated brass. The non-ferrous alloy contacts are heat-treated after forming and then silver-plated. Three silver-plated brass toe clamps are supplied for mounting purposes.

The socket insulating material is chemically inert, non-flammable, and will not absorb water or water vapor. It is not affected by strong or weak acids or alkalies. It will not react to normal solvents except in the case of halogenated compounds, which will induce minor dimensial changes. Its physical characteristics are stable over a temperature range of -150 C to $\pm$275 C°and it is resistant to embrittlement and thermal shock.

A silver-mica dielectric is used in the screen-grid by-pass capacitor.

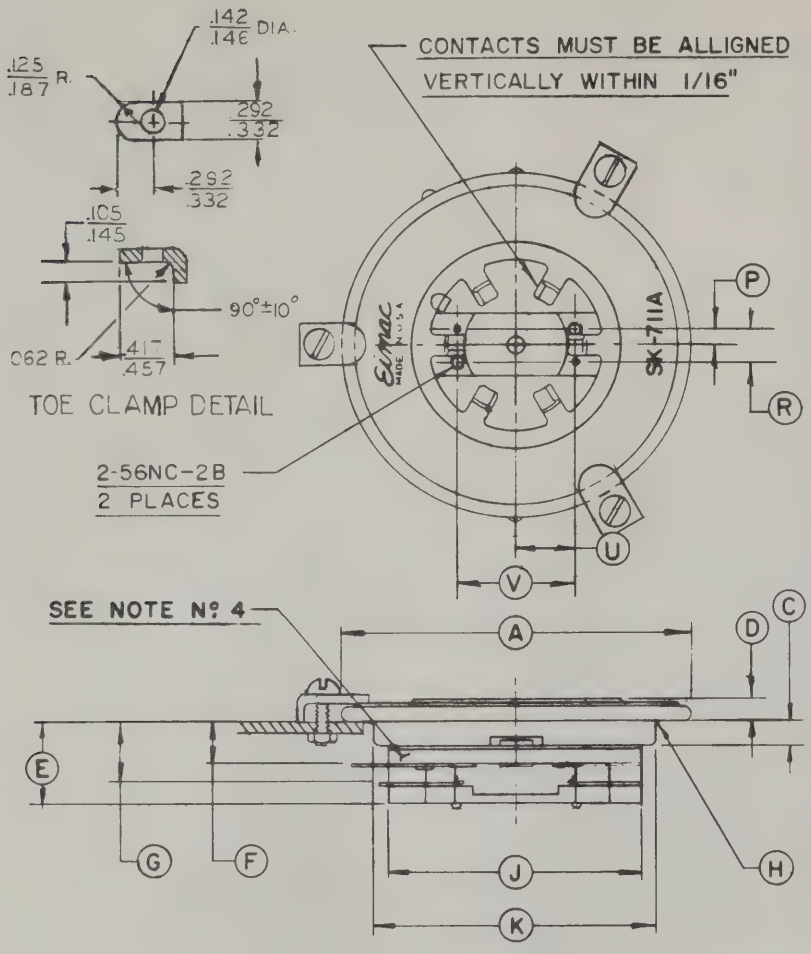
AIR CHIMNEY

The SK-606 is intended to be used with the 4CX300A mounted vertically with the anode up. If horizontal mounting or vertical mounting with the anode down is required, means should be provided to retain the chimney. The air chimney is made of high-temperature ceramic and serves to direct the flow of air emerging from the socket into the anode cooling fins. It is recommended that the SK-606 chimney, or its equivalent, be used with each SK-711A socket.

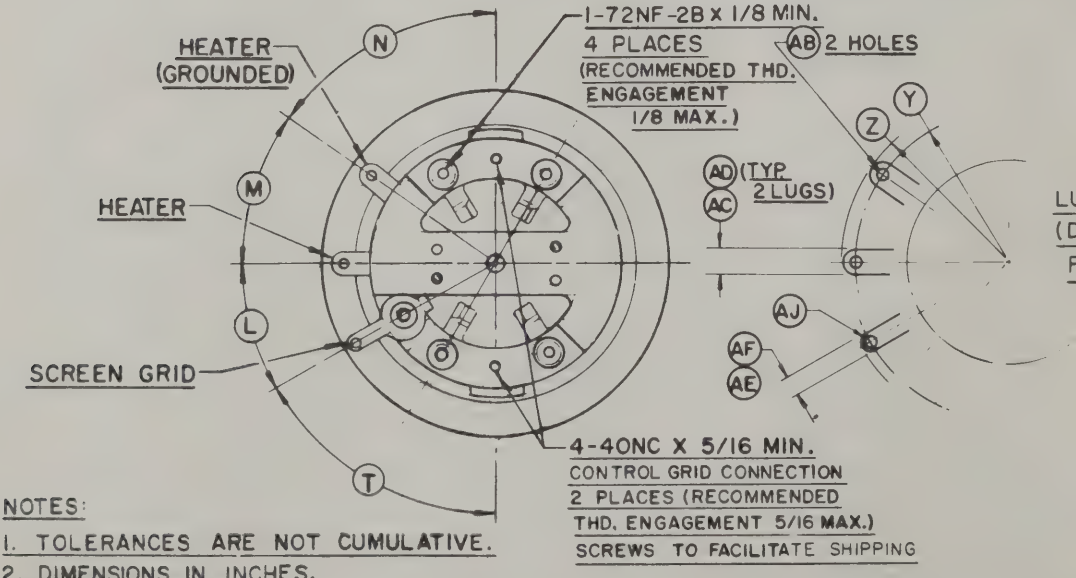
The SK-711A Is Recommended For Use With The Following Tubes:

4CX300A 4CX300Y 4CX125C 4CX125F 4CN15A

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DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	2.688 O.D.	2.750 O.D.	
B			
C	.175	.207	
D	.156	.218	
E	.600	.650	
F	.312	.352	
G	.453	.493	
H			.031 R.
J			2 DIA.
K	2.184 O.D.	2.210 O.D.	
L			30°
M			35°
N			55°
P	.109	.141	
R	.234	.266	
S			
T			60°
U	.437	.469	
V	.890	.922	
W			
X			
Y			1 13/64 R
Z			1 5/16 R
AB			1/16 DIA.
AC			3/16
AD			1/32 THK.
AE			1/8
AF			.020 THK.
AG			
AJ			1/16 DIA.



LUG DIMENSIONS
(DETAILS OMITTED
FOR CLARITY)

NOTES:

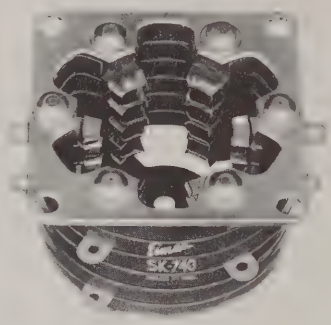
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES.
3. BY-PASS CAPACITOR RATING:
   CAPACITANCE-1100 MMFD.± 25%
   VOLTAGE BREAKDOWN – 350 VDC. AT 60,000 FT.
4. INSULATING BODY RING MADE OF DIALLYL ISOPHTHALATE PER MIL-M-19833.

THE CAPACITOR IS A SEALED UNIT.
SOCKET CAPABLE OF OPERATING AT
350 VDC IN AN AMBIENT TEMP. OF
-65°C TO 185°C.
BODY OF THE SOCKET AND CONTACTS
ARE SILVER PLATED.

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

SK-740

AIR-SYSTEM SOCKET



The Eimac SK-740 air-system socket is recommended for use with those tubes listed at the bottom of the page or other tube types having this special breech-block base. This socket is not intended for use with an air-chimney, but is particularly useful in applications where transverse air cooling, heat-sink or immersion cooling is intended. When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-740 is humidity and salt-spray resistant.

BASE CONNECTIONS

The SK-740 socket consists of five sets of ring contacts: they are from top to bottom: 1. screen-grid, 2. control-grid, 3. cathode, 4. heater, 5. heater. Each set of contacts consist of six separate contacting tabs. The tube elements are connected to their external circuits by two diametrically-opposed solder tabs. The SK-740 has no grounded contacts.

MATERIALS AND FINISHES

The mounting plate of the socket is fabricated of nickel-plated brass. The contact rings and tabs are of beryllium copper, per QQ-C-533, heat-treated after forming, then silver-plated. The rivets and washers are of brass, silver and nickel-plated respectively. All silver-plating per QQ-S-365 and nickel-plating per QQ-N-290. The ten contact terminals are solder-dipped to insure firm, dependable solder contact. The insulating wafers and the stop yoke of the socket are molded of a flameproof diallyl meta-phthalate, per MIL-M-19833.

INSTALLATION

The SK-740 air-system socket is designed for under-chassis mounting and requires a 1.593 inches diameter hole through the chassis deck. Four screw holes are provided for fastening as shown in the outline drawing.

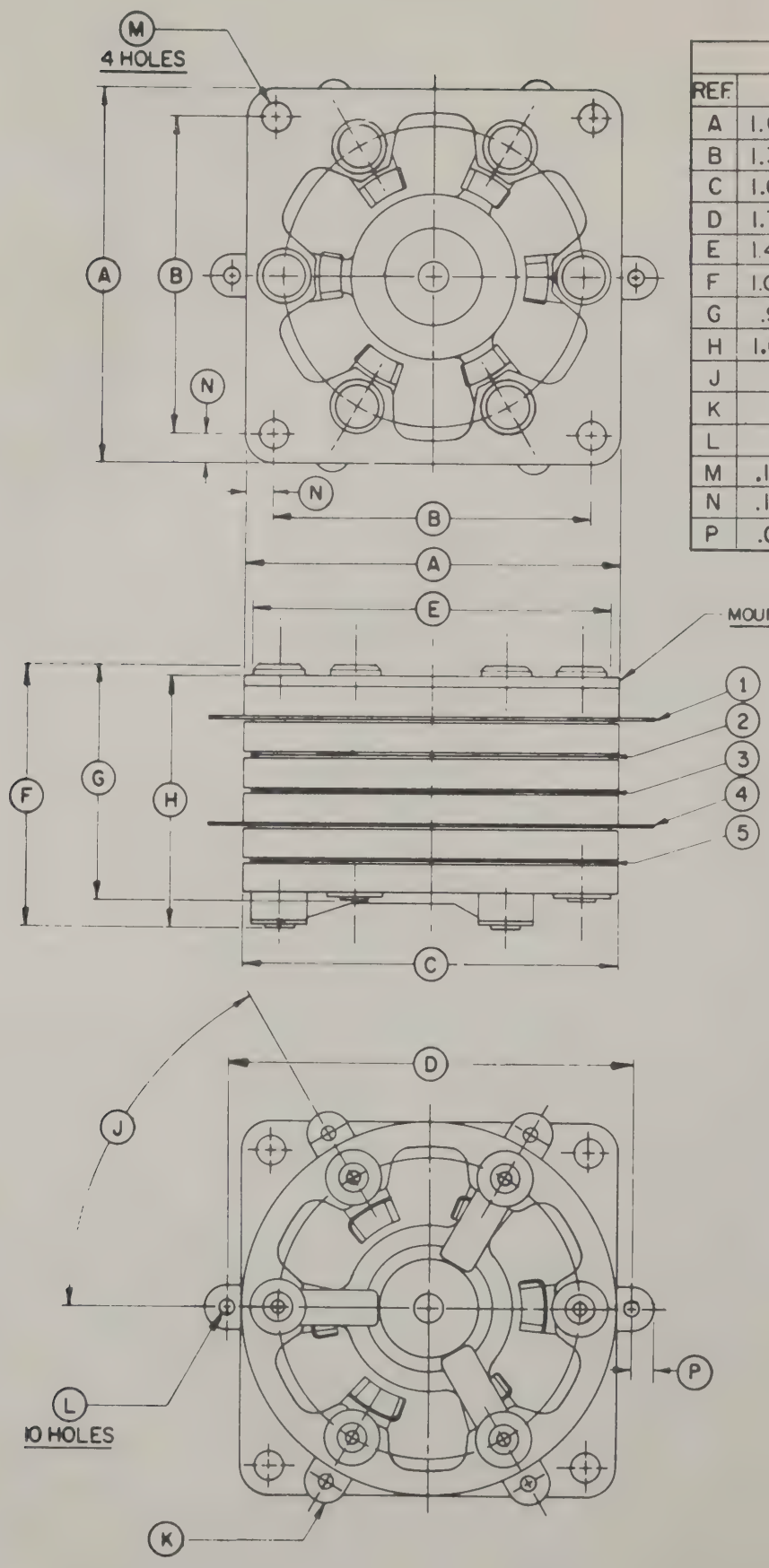
The SK-740 Air-System Socket Is Recommended For Use With The Following Tube Types:

4CN15A	4CX300A
4CX125C	4CX300Y
4CX125F	

Note: A separate means of directing air is required when using the SK-740 with the 4CX300A and 4CX300Y. For applications using these two tubes, the SK-760 and SK-770 Air-System Sockets are recommended. These contain an integral chimney.

NET WEIGHT . . . . . 1.5 ounces

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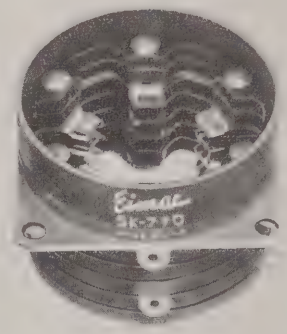
DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	1.615	1.635	
B	1.360	1.390	
C	1.615 DIA.	1.635 DIA.	
D	1.735	1.765	
E	1.485	1.575	
F	1.070	1.110	
G	.925	.965	
H	1.020	1.060	
J			60°
K			3/32R
L			1/16 DIA.
M	.134 DIA.	.154 DIA.	
N	.120	.130	
P	.078	.109	

CONNECTIONS

1. SCREEN GRID
2. CONTROL GRID
3. CATHODE
4. HEATER
5. HEATER

SK-760
SK-770

AIR-SYSTEM SOCKETS



The Eimac SK-760 and SK-770 air-system sockets are recommended for use with those tubes listed at the bottom of the page or other tube types having this special breach - block base. These sockets incorporate a built-in integral chimney. When these sockets are used, connection is made to each of the tube electrodes except the anode. The screen contacts on the SK-760 are not connected to the metal mounting plate, while the screen contacts on the SK-770 are connected to the metal mounting plate. The SK-760 has no grounded contacts. The SK-760 and SK-770 are humidity and salt spray resistant.

BASE CONNECTIONS

The SK-760 and SK-770 air-system sockets consist of five sets of ring contacts; they are from top to bottom: 1. screen-grid. 2. control-grid. 3. cathode. 4. heater. 5. heater. Each set of contacts consist of six separate contacting tabs. The tube elements are connected to their external circuits by two diametrically opposed solder tabs.

MATERIALS AND FINISHES

The mounting plates of these sockets are fabricated of silver-plated brass. Contact rings and tabs are made of beryllium copper, per QQ-C-533, heat-treated after forming, then silver-plated. The rivets and washers are of brass, silver and nickel-plated respectively. All silver-plating is in accordance with QQ-S-365 and nickel-plating per QQ-H-290. The ten contact terminals are solder-dipped to insure firm, dependable solder contact. The insulating wafers and the stop yoke of the sockets are molded of a flameproof diallyl metaphthalate per MIL-M-19833.

INSTALLATION

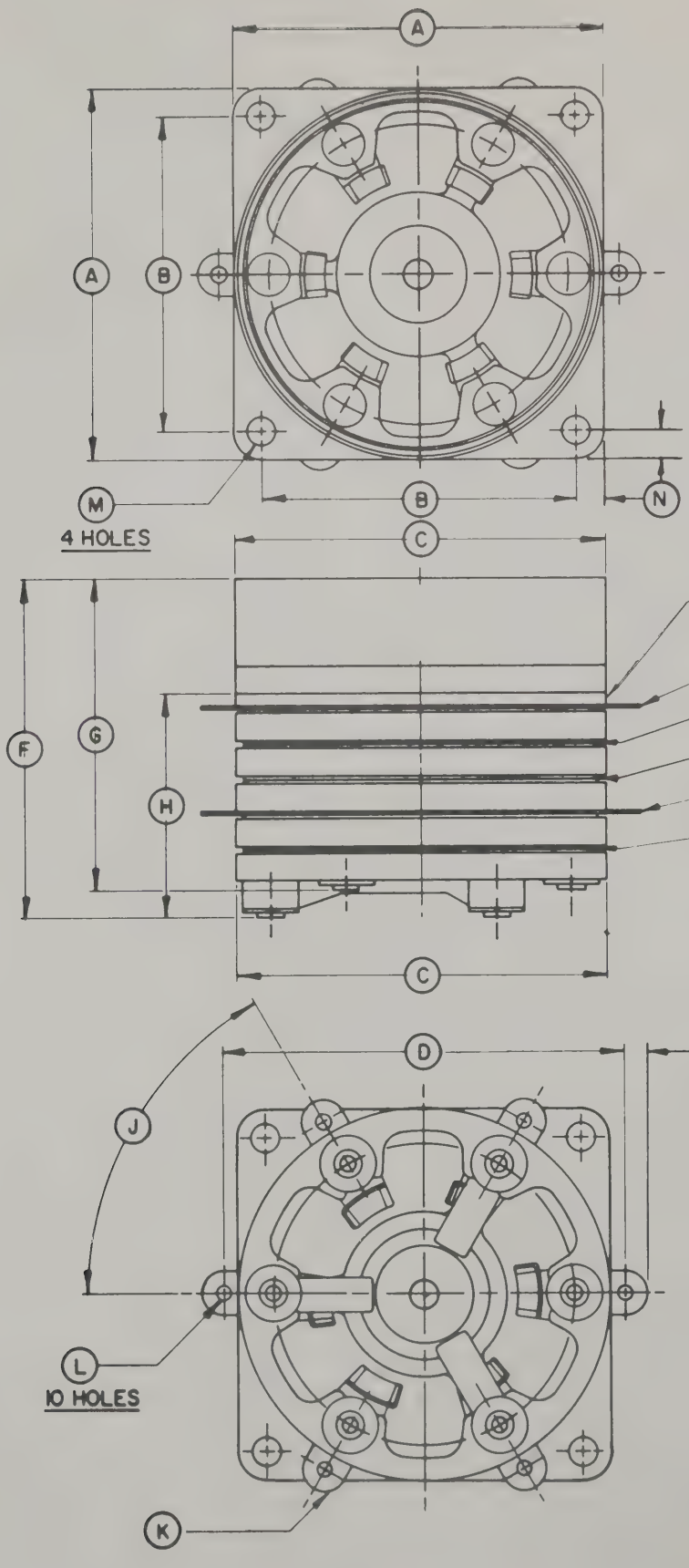
The SK-760 and SK-770 air-system sockets were designed for under-chassis mounting and require a 1.593 inches diameter hole through the chassis deck and four screw holes are provided for fastening as shown on the outline drawing.

The SK-760 and SK-770 Air-System Sockets Are Recommended For Use With The Following Tube Types:

4CX300A 4CX300Y

NET WEIGHT . . . . . 1.5 ounces

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DIMENSIONS IN INCHES

DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	1.615	1.635	
B	1.360	1.390	
C	1.615 D.	1.635 D.	
D	1.735	1.765	
F	1.330	1.370	
G	1.205	1.245	
H	.931	.971	
J			60°
K			3/32 R.
L			1/16 DIA.
M	.134 D.	.154 D.	
N	.120	.130	
P	.078	.109	

CONNECTIONS

1. SCREEN GRID
2. CONTROL GRID
3. CATHODE
4. HEATER
5. HEATER

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

SK-800A
AIR-SYSTEM SOCKET UNGROUNDED CATHODE TERMINALS

SK-806
AIR CHIMNEY

The Eimac SK-800A is one of the air-system sockets recommended for use with the Eimac 4CX1000A or 4CW2000A tetrodes. A companion SK-806 Air Chimney is also available and is recommended for use with the socket when the air-cooled 4CX1000A is to be employed.

When this socket is used, connection is made to each of the tube electrodes, except the anode, and to one side of the integral screen-grid by-pass capacitor. The SK-800A is humidity and salt-spray resistant.



SK-800A



SK-800A WITH CHIMNEY

BASE CONNECTIONS

The SK-800A socket consists of three sets of spring-finger contacts for each tube electrode (to assure low-inductance contact), a center guide pin to facilitate tube installation, and an integral screen by-pass capacitor. The terminals are shown on the outline drawing.

When the socket is mounted on a grounded chassis, no tube electrodes are automatically grounded. Connection to the cathode and one side of the heater is made via the second set of spring-finger contacts from the bottom of the socket.

SCREEN-GRID BY-PASS CAPACITOR

This capacitor utilizes polyester film as a dielectric and is encapsulated in epoxy resin. Its capacitance is 1500 uufds ± 20 percent and it is rated at 400 d-c working volts. One side connects to the three screen-grid tabs on the tube and the other side is connected directly to the socket body.

MATERIALS & FINISHES

The metal shell, or body, of the socket is fabricated of silver-plated brass, while the mounting base and centering pin are of nickel-plated brass. All contacts are formed of a non-ferrous alloy, heat-treated and silver-plated. Contact insulating material is high-temperature ceramic.

INSTALLATION

The SK-800A Air-System Socket is designed for under-chassis mounting and requires a 5-1/16-inch hole through the chassis deck. The socket is held in place by the three toe clamps provided. One side of the screen-grid by-pass capacitor is automatically grounded to the chassis when this mounting method is used.

AIR CHIMNEY

The SK-806 Air Chimney is molded of fiberglass-reinforced silicone resin. It effectively directs the flow of air to the anode cooling fins with minimum pressure drop and is recommended for use with each SK-800A when the air-cooled 4CX1000A is to be socketed.

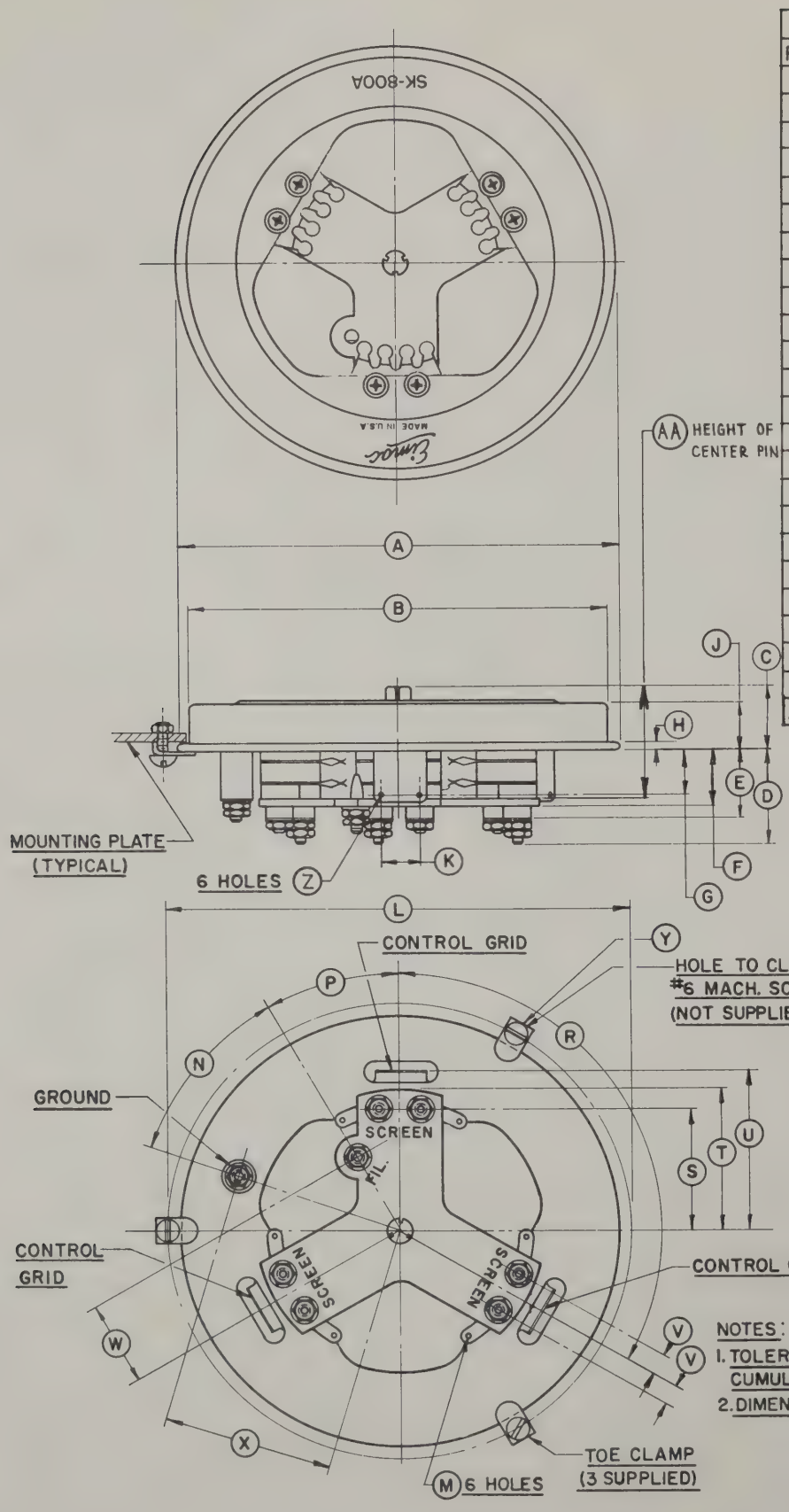
SK-800A:

Net Weight	18 ounces

SK-806:

Net Weight	3¼ ounces
Maximum Height	1⅞ inches
Maximum Diameter	6⅛ inches

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DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	5.290	5.330	
B	5.027	5.047	
C	.690	.730	
D	1.100	1.170	
E	.734	.774	
F	.641	.681	
G	.500	.540	
H	.110	.140	
J	.510	.540	
K	.480	.520	
L			5.595
M	.057 DIA.	.077 DIA.	
N	40°	42°	
P	29°	31°	
R	119°	121°	
S	1.490	1.530	
T	1.699	1.739	
U	1.917	1.957	
V	.245	.255	
W	1.052	1.072	
X	2.052	2.072	
Y	.142 DIA.		
Z	.052 DIA.	.072 DIA.	
AA	1.246	1.286	

NOTES:
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES.

Printed in U S A 588

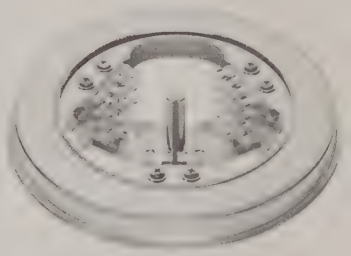
EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

SK-810
AIR-SYSTEM SOCKET GROUNDED CATHODE TERMINALS

SK-806
AIR CHIMNEY

The Eimac SK-810 is one of the air-system sockets recommended for use with the Eimac 4CX1000A or 4CW2000A tetrodes. A companion SK-806 Air Chimney is also available and is recommended for use with the socket when the air-cooled 4CX1000A is to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode, and to one side of the integral screen-grid by-pass capacitor. The SK-810 is humidity and salt-spray resistant.



SK-810



SK-810 WITH CHIMNEY

BASE CONNECTIONS

The SK-810 socket consists of three sets of spring-finger contacts for each tube electrode (to assure low-inductance contact), a center guide pin to facilitate tube installation, and an integral screen by-pass capacitor. The terminals are shown on the outline drawing.

When this socket is mounted on a grounded chassis, the cathode and one side of the heater will be automatically grounded. A grounding terminal is provided and may be used for positive connection if desired.

SCREEN-GRID BY-PASS CAPACITOR

This capacitor utilizes polyester film as a dielectric and is encapsulated in epoxy resin. Its capacitance is 1500 uufds ± 20 percent and it is rated at 400 d-c working volts. One side connects to the three screen-grid tabs on the tube and the other side is connected directly to the socket body.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is fabricated of silver-plated brass, while the mounting base and centering pin are of nickel-plated brass. All contacts are formed of a non-ferrous alloy, heat treated and silver plated. Contact insulating material is high-temperature ceramic.

INSTALLATION

The SK-810 Air-System Socket is designed for under-chassis mounting and requires a 5-1/16-inch hole through the chassis deck. The socket is held in place by the three toe clamps provided. One side of the screen-grid by-pass capacitor is automatically grounded to the chassis when this mounting method is used.

AIR CHIMNEY

The SK-806 Air Chimney is molded of fiberglass-reinforced silicone resin. It effectively directs the flow of air to the anode cooling fins with minimum pressure drop and is recommended for use with each SK-810 when the air-cooled 4CX1000A is to be socketed.

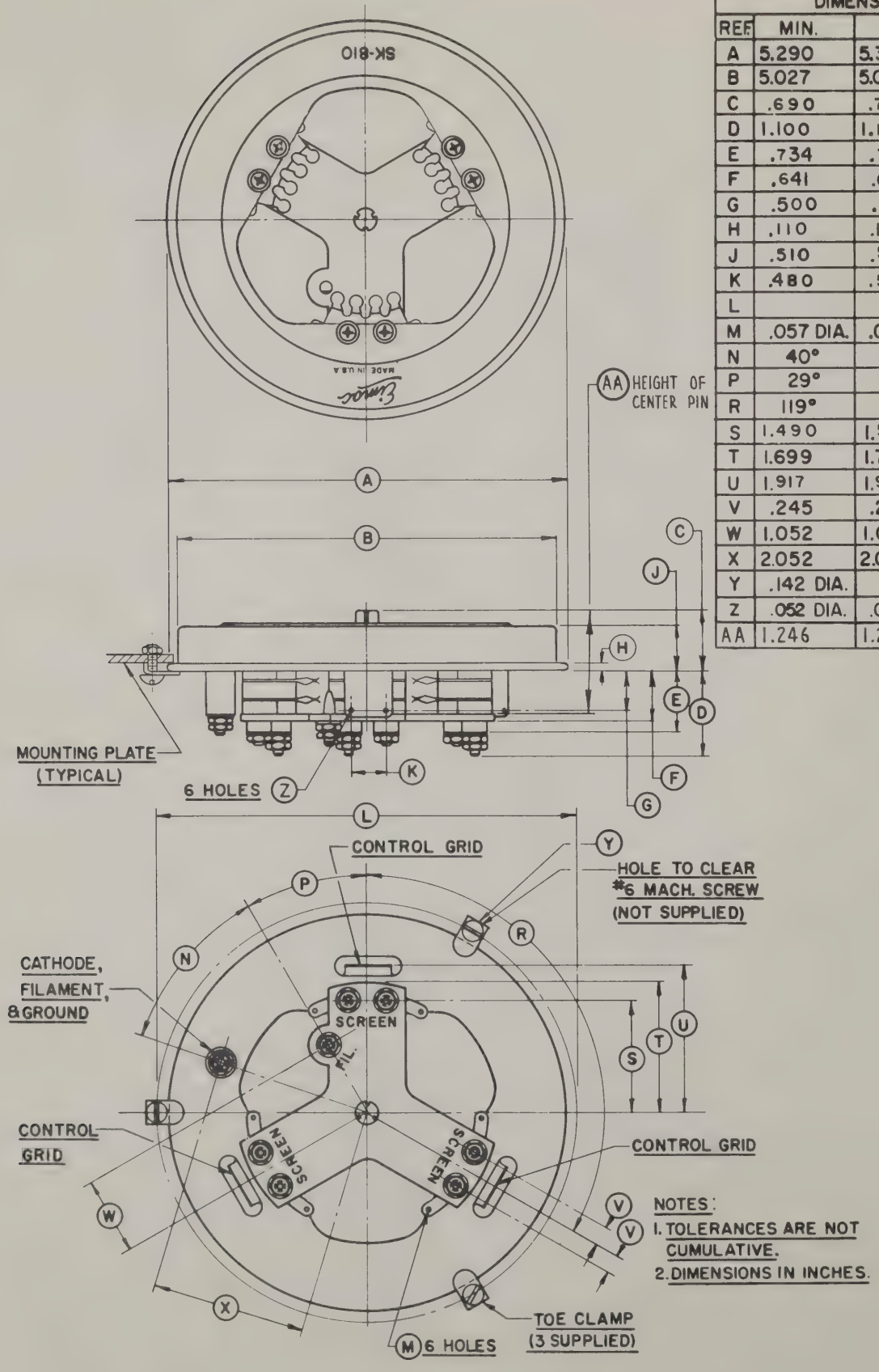
SK-810:

Net Weight	18 ounces

SK-806:

Net Weight	3¼ ounces
Maximum Height	1⅞ inches
Maximum Diameter	6⅛ inches

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DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	5.290	5.330	
B	5.027	5.047	
C	.690	.730	
D	1.100	1.170	
E	.734	.774	
F	.641	.681	
G	.500	.540	
H	.110	.140	
J	.510	.540	
K	.480	.520	
L			5.595
M	.057 DIA.	.077 DIA.	
N	40°	42°	
P	29°	31°	
R	119°	121°	
S	1.490	1.530	
T	1.699	1.739	
U	1.917	1.957	
V	.245	.255	
W	1.052	1.072	
X	2.052	2.072	
Y	.142 DIA.		
Z	.052 DIA.	.072 DIA.	
AA	1.246	1.286	

NOTES:
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES.

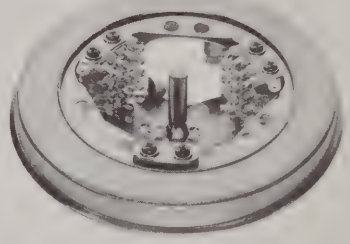
Eimac®

EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

SK-890
AIR-SYSTEM SOCKET GROUNDED CATHODE TERMINALS
SK-806
AIR CHIMNEY

The Eimac SK-890 is one of the air-system sockets recommended for use with the Eimac 4CX1000A or 4CW2000A tetrodes. The SK-890 is especially designed for use at frequencies where series screen neutralization is employed and is so constructed that the screen-grid can be series tuned to ground through the screen by-pass capacitor. A companion SK-806 Air Chimney is also available and is recommended for use with the socket when the air-cooled 4CX1000A is to be employed.

When this socket is used, connection is made to each of the tube electrodes except the anode. The SK-890 is humidity and salt-spray resistant.



SK-890



SK-890 WITH CHIMNEY

BASE CONNECTIONS

The SK-890 socket consists of three sets of spring-finger contacts for each tube electrode (to assure low-inductance contact), a center guide pin to facilitate tube installation, and an integral screen by-pass capacitor. The terminals are shown on the outline drawing.

When this socket is mounted on a grounded chassis, the cathode and one side of the heater will be automatically grounded. A grounding terminal is provided and may be used for positive connection if desired.

SCREEN-GRID BY-PASS CAPACITOR

This capacitor utilizes polyester film as a dielectric and is encapsulated in epoxy resin. Its capacitance is 1500 uufds ±20 percent and it is rated at 400 d-c working volts. The socket is so orientated that the three sets of spring finger contacts which connect to the screen-grid tabs of the tube are not connected to the upper, ungrounded side of the screen-grid capacitor. A series of six holes are provided in the upper capacitor deck to allow the installation of the screen neutralizing device; this device is connected between each of the solder terminals provided in the screen spring finger contacts and the upper capacitor deck. The lower capacitor deck is connected directly to the socket body.

MATERIALS AND FINISHES

The metal shell, or body, of the socket is fabricated of silver-plated brass, while the mounting base and centering pin are of nickel-plated brass. All contacts are formed of a non-ferrous alloy, heat treated and silver-plated. Contact insulating material is high-temperature ceramic.

INSTALLATION

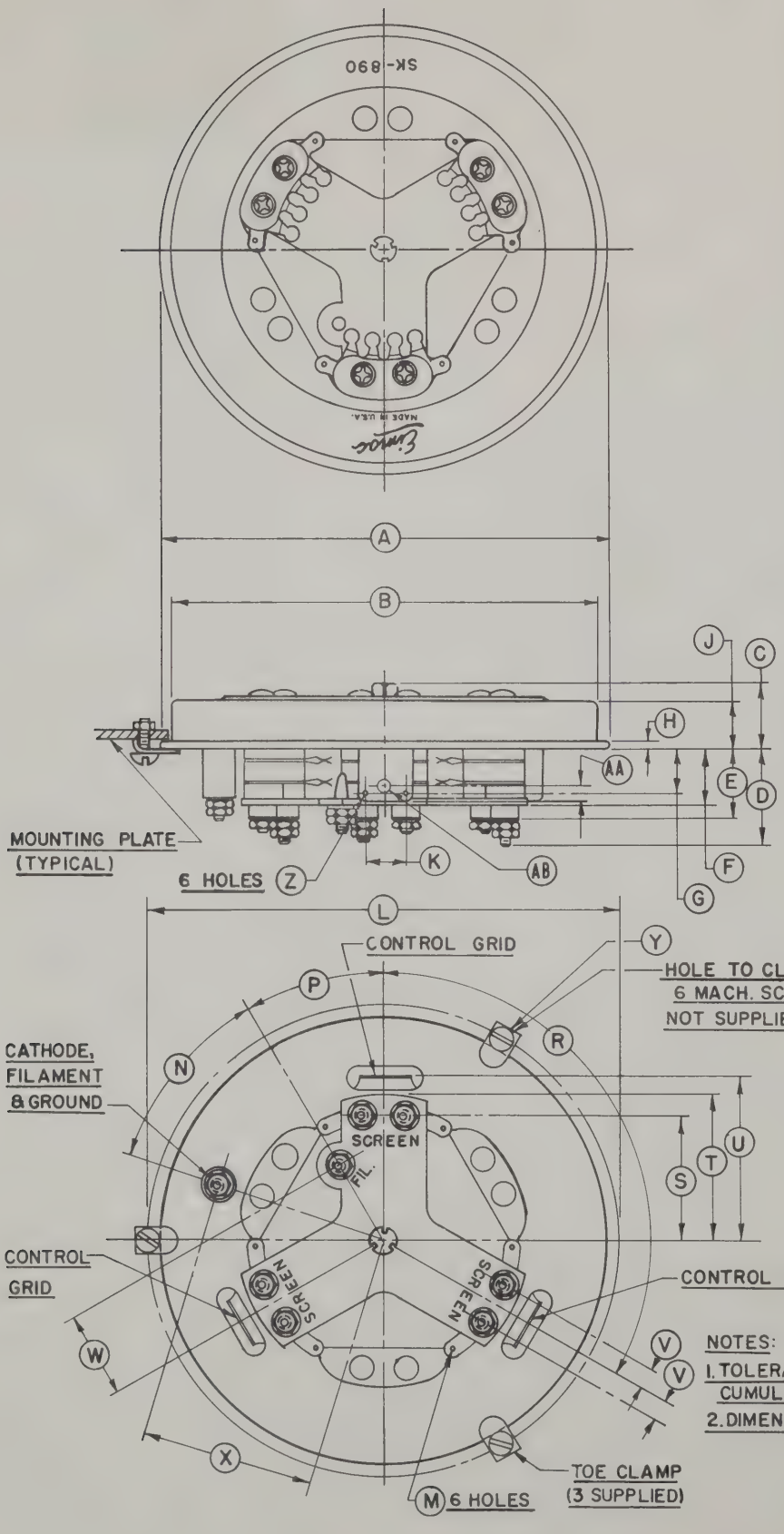
The SK-890 Air-System Socket is designed for under-chassis mounting and requires a 5-1/16-inch hole through the chassis deck. The socket is held in place by the three toe clamps provided. One side of the screen-grid by-pass capacitor is automatically grounded to the chassis when this mounting method is used.

AIR CHIMNEY

The SK-806 Air Chimney is molded of fiberglass-reinforced silicone resin. It effectively directs the flow of air to the anode cooling fins with minjmum pressure drop and is recommended for use with each SK-890 when the air-cooled 4CX1000A is to be socketed.

SK 890:	
Net Weight	18 ounces
SK-806:	
Net Weight	3¼ ounces
Maximum Height	1⅞ inches
Maximum Diameter	6⅝ inches

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DIMENSION DATA			
REF.	MIN.	MAX.	NOM.
A	5.290	5.330	
B	5.027	5.047	
C	.790	.860	
D	.990	1.130	
E	.640	.680	
F	.550	.590	
G	.420	.500	
H	.110	.140	
J	.500	.540	
K	.480	.520	
L			5.595
M	.057 DIA.	.077 DIA.	
N	40°	42°	
P	29°	31°	
R	119°	112°	
S	1.485	1.530	
T	1.699	1.739	
U	1.917	1.957	
V	.245	.255	
W	1.052	1.072	
X	2.052	2.072	
Y	.142 DIA.		
Z	.078 DIA.	.108 DIA.	
AA			.234
AB	.156 DIA.	.186 DIA.	

NOTES:
1. TOLERANCES ARE NOT CUMULATIVE.
2. DIMENSIONS IN INCHES

Printed in U S A 588

A DATA SHEET FOR THE SR-900 IS BEING PREPARED AND WILL BE MAILED TO YOU
FOR INSERTION IN THIS CATALOG

EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X4523

CAVITY AMPLIFIER

FREQUENCY
2.2 TO 2.3 kMc

Power Output
20 Watts CW



The Eitel-McCullough Model X4523 cavity amplifier is a compact modular amplifier readily adaptable to airborne or ground support telemetry systems. The Model X4523 is a result of combined tube and circuit technology that serves to optimize the tube configuration with the associated RF circuit. Maximum efficiency and RF output from a very small package are salient features offered by this amplifier. Tuning can be accomplished with a minimum of test equipment.

CHARACTERISTICS

FREQUENCY 2.2-2.3 kMc

ELECTRICAL

Tube Type		Eimac Y-319
Power Supply Requirements:		
Anode	1000	V
Current	75	mA
Heater	6.0	V
Current	1.0	A
Operating Charactdristics:		
Power Input	2.0	W
Power Output	20	W
Service		CW/FM
Bandwidth	10	Mc
Frequency Stability	20	PPM/°C
Load Impedance	50	ohms
Load VSWR	1.5:1	Any Ø

MECHANICAL

Connectors	Type BRM Bendix
Cooling	Conduction
Maximum Overall Dimensions	1.25" x1.25" x3.0"
Net Weight	0.56 pounds

ENVIRONMENTAL

Mounting Surface Temperature	-40 to +100°C
Vibration	Shall meet the requirements of Method 514, MIL-Standard-810, Class 1 through 4 and mounting Type A.
Shock	Shall meet the requirements of Procedure 1, Method 516 of MIL-Standard-810.

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EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X4524

CAVITY AMPLIFIER

FREQUENCY
2.2 TO 2.3 kMc

Power Output
80 Watts CW



Simultaneous development programs concerned with tube technology and RF cavities has resulted in the Model X4524 cavity amplifier. Because of its compact modular construction the Model X4524 can be applied to previously difficult or impossible technical programs where weight and size versus power output are pertinent factors. Additional advantages include ease of mounting and tuning. The latter is accomplished with a minimum of instrumentation.

CHARACTERISTICS

FREQUENCY 2.2 - 2.3 kMc

ELECTRICAL

Tube Type		EIMAC X843E
Power Supply Requirements:		
Anode	1000	V
Current	250	mA
Heaters	6.0	V
Current	2.1	A
Operating Characteristics:		
Power Input	8.0	W
Power Output	80	W
Service		CW/FM
Bandwidth		15 Mc
Frequency Stability		20 PPM/°C
Load Impedance	50	ohms
Load VSWR		1.5:1 Any Ø

MECHANICAL

Connectors	BRM Bendix
Cooling	Conduction
Maximum Overall Dimensions	2" x2" x5.0"
Net Weight	2.03 pounds

ENVIRONMENTAL

Mounting Surface Temperature	-40 to +100°C
Vibration	Shall meet the requirements of Method 514, MIL-Standard-810, Class 1 through 4 and mounting Type A
Shock	Shall meet the requirements of Procedure 1, Method 516 of MIL-Standard-810

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EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X4539

CAVITY AMPLIFIER

FREQUENCY
1.435-1.535 kMc

Power Output
20 Watts CW



The Eitel-McCullough Model X4539 cavity amplifier is a compact modular amplifier readily adaptable to airborne or ground support telemetry systems. The Model X4539 is a result of combined tube and circuit technology that serves to optimize the tube configuration with the associated RF circuit. Maximum efficiency and RF output from a very small package are salient features offered by this amplifier. Tuning can be accomplished with a minimum of test equipment.

CHARACTERISTICS

FREQUENCY 1.435-1.535 kMc

ELECTRICAL

Tube Type	Eimac Y-319	
Power Supply Requirements:		
Anode	1000	V
Current	63	mA
Heater	6.0	V
Current	1.0	A
Operating Characteristics:		
Power Input	2.0	W
Power Output	20	W
Service	CW/FM	
Bandwidth	10	Mc
Frequency Stability	20	PPM/°C
Load Impedance	50	ohms
Load VSWR	1.5:1	Any Ø

MECHANICAL

Connectors	Type BRM Bendix
Cooling	Conduction
Maximum Overall Dimensions	1.25" x1.25" x4.5"
Net Weight	0.84 pounds

ENVIRONMENTAL

Mounting Surface Temperature	-40 to +100°C
Vibration	Shall meet the requirements of Method 514, MIL-Standard-810, Class 1 through 4 and mounting Type A.
Shock	Shall meet the requirements of Procedure 1, Method 516 of MIL-Standard-810.

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SAN CARLOS, CALIFORNIA

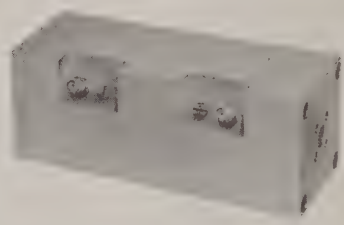
TENTATIVE DATA

X4540

CAVITY AMPLIFIER

FREQUENCY
1.435 TO 1.535 kMc

Power Output
80 Watts CW



Simultaneous development programs concerned with tube technology and RF cavities has resulted in the Model X4540 cavity amplifier. Because of its compact modular construction the Model X4540 can be applied to previously difficult or impossible technical programs where weight and size versus power output are pertinent factors. Additional advantages include ease of mounting and tuning. The latter is accomplished with a minimum of instrumentation.

CHARACTERISTICS

FREQUENCY 1.435-1.535 kMc

ELECTRICAL

Tube Type		EIMAC X843E
Power Supply Requirements:		
Anode	1000	V
Current	220	mA
Heaters	6.0	V
Current	2.1	A
Operating Characteristics:		
Power Input	8.0	W
Power Output	80	W
Service		CW/FM
Bandwidth		15 Mc
Frequency Stability		20 PPM/°C
Load Impedance	50	ohms
Load VSWR		1.5:1 Any Ø

MECHANICAL

Connectors	BRM Bendix
Cooling	Conduction
Maximum Overall Dimensions	2" x2" x7.5"
Net Weight	3.05 pounds

ENVIRONMENTAL

Mounting Surface Temperature	-40 to +100° C
Vibration	Shall meet the requirements of Method 514. MIL-Standard-810. Class 1 through 4 and mounting Type A
Shock	Shall meet the requirements of Procedure 1. Method 516 of MIL-Standard-810

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EITEL-McCULLOUGH, INC.
SAN CARLOS, CALIFORNIA

TENTATIVE DATA

X4546

CAVITY AMPLIFIER
150-2000 Mc

The Eimac X4546 is a broad-tuning cavity amplifier incorporating the Eimac Y-319 ceramic metal planar triode. It is intended for use in test equipment consoles and special transmitters. This amplifier has front-panel tuning knobs and frequency scales for tuning across the 150-2000 Mc band with power output from 25 to 5 watts.

CHARACTERISTICS

ELECTRICAL

Frequency, continuously tunable - - - - - - - - - - 150-2000 Mc

RF Power Output -

Frequency, Mc	Power output, watts, CW
150- 900	40
900-1400	30
1400-1800	20
1800-2000	10

RF Drive Power Required - - - - - - - - - - - - - - - - - - -

CAVITY AMPLIFIERS

